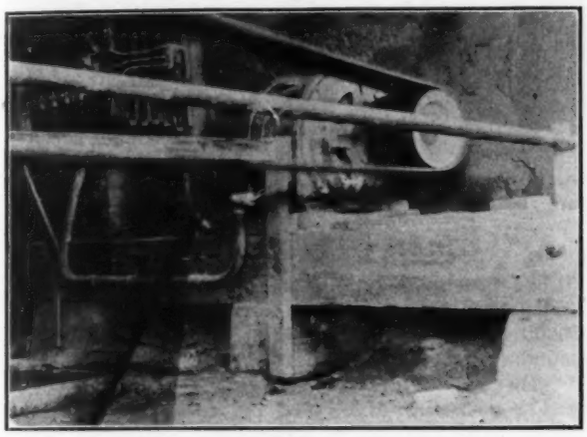
Electrical Review

WITH WHICH IS CONSOLIDATED WESTERN ELECTRICIAN AND ELECTROCRAFT.

Vol. 72.—No. 26. CHICAGO, SATURDAY, JUNE 29, 1918. Page 1067.



Motor Driving a Crusher, Showing Motor-Control Panel.

100-Horsepower Motor, Driving the No. 8 Gyratory Crusher.

Electrically Operated Quarry and Rock-Crushing Plant in Chicago

Features of Artesian Limestone Company's Property — Electric Power Applied for Drills, Haulage, Crushers and Screens

ONE of the most remarkable limestone quarries in the United States is situated within the city limits of Chicago and only about three miles from its main business district. Quarrying operations have been carried on there for over 30 years, and the crushed-stone output from the property during that period has found a ready market in the city for concrete and macadam work. The quarry and crushing plant belong to the Artesian Limestone Company and are located at Grand and Campbell Avenues. The ground in this locality is practically level and rock is found close to the surface.

As one approaches the cube-shaped, open pit of the depth of 275 feet, he obtains a view that is rather striking. Measured laterally, the excavation is about 300 feet square. It is bounded by perpendicular walls except that, on the side next to the crushing plant, a segment or projection of rock is left in place to support a double-track inclined tramway. This segment has a surface slope from the top rim of the pit to a point on the bottom 100 feet from the wall, giving the tramway an inclination of about 45 degrees.

The exposed walls show this deposit to be a body of clear, white limestone, occurring in regular horizontal stratification from the surface to the lowest level of the pit. The good quality of the material is evidenced by its texture and by the ever ready market for it. Of the output of crushed stone from the property, about 75 per cent is delivered by motor trucks to Chicago customers.

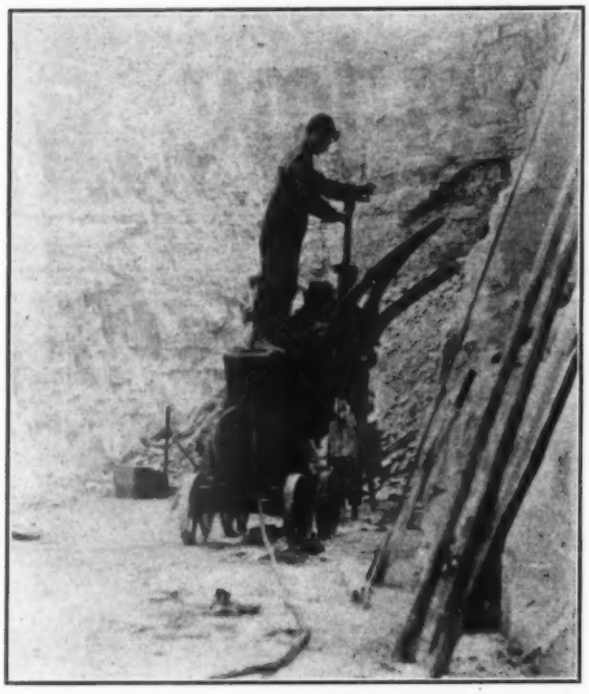
Tramway and Electric Power Lines.

The 36-inch-gauge tramway tracks are laid upon a timber structure, the latter resting upon the rock surface. The length of the tramway, from the upper terminal in the mill to the lower terminal in the pit, is close to 400 feet.

Below the tracks and supported by the timber structure are the insulated electric power lines which are extended from the outdoor transformer bank on the surface into the pit for motor operating. At a place up the incline, about 50 feet from the base, is an air compressor, driven by a 20-horsepower motor, from which compressed air is supplied to piston drills. Electric lines from this circuit are also run to a motor-operated churn drill and other electrically operated drilling units.

A steam line, extended from a boiler in the surface plant down the tramway line to the bottom of the pit, furnishes power for a Worthington duplex pump of 300 gallons' capacity, by which the accumulation of seepage and spring water in a sump at the lowest level is lifted to the surface and discharged into the sewer.

It is understood, however, that this steam pump, which has proven troublesome in very cold weather, is to be replaced by an electrically driven centrifugal pump, requiring a 50-horsepower motor. This, with the electric power now used in the pit, will bring the amount up to 116 horsepower for drill work and pumping.



Portable Drilling Unit. Motor-Driven Compressor Operating Sullivan Air Drill.

Drilling and Other Pit Operations.

The quarry operations are being carried on at four different levels. About two-thirds of the pit area consists of a main floor, with two narrow benches above it, with about one-fourth of the area taken up by a lower floor, 25 feet deeper. One of the upper benches, next to the south wall, is 25 feet higher than the main floor, and the other about 75 feet higher. These benches are bases for drilling operations, where 15-foot vertical holes are drilled by the use of the movable, motor-driven air compressor, connected to the drill by air lines. This small drilling unit is operated from an electric line carried in a flexible duct from the transformer down the side of the perpendicular wall to the motor. In this bench work five to seven holes are shot at a time. The rock thus broken is much of it in pieces too large to handle and is further broken up by drilling holes with small air drills and then blasting.

A churn drill, with a 5-inch-diameter bit, operated by a 10-horsepower motor, is kept in action on the main level, on the east side of the pit. The vertical 5-inch holes thus driven extend to a depth of 25 feet or to the level of the lower pit floor. By drilling and blasting on that bench the operators have a 25-foot face of broken rock to work against from the lowest floor. In the same manner as described above, the large pieces are drilled and then rebroken by blasts, using drills operated by compressed air from the compressor plant under the incline.

Loading, Hauling and Hoisting.

There are no steam shovels in this deep quarry, all broken rock being loaded into 2-yard cars by hand. These cars are run on movable tracks between the foot of the incline and the several loading points. One branch of the incline extends down to the lowest pit level, and the other terminates at the main quarry level, so that cars of rock may be sent up the incline from both working levels. At present, about 300 cars, holding 2 yards each, are pulled up the incline each day of 10 hours, making an output of about 600 cubic yards per day.

Cars are moved up and down the 400-foot incline by two cables, each one attached to an electrically operated winding drum installed in the crushing plant on the surface, the motion of each hoist being controlled by an operator, whose station gives him a view of the incline, the dumping devices and the hoists or drums.

A car of rock, as it enters the plant, is automatically dumped into the feed hopper of an Austin No. 8 gyratory crusher. As a car at the upper terminal is being dumped and started back, a loaded car is being started up from the lower terminal, making an up and down trip at the same time, so that the load is partly counterbalanced. The capacity of the hoisting equipment is much greater than that now utilized. The two winding drums are driven by a 150-horsepower motor which is connected by belt to a shaft having a friction clutch at each end that makes friction contact with the hoist.

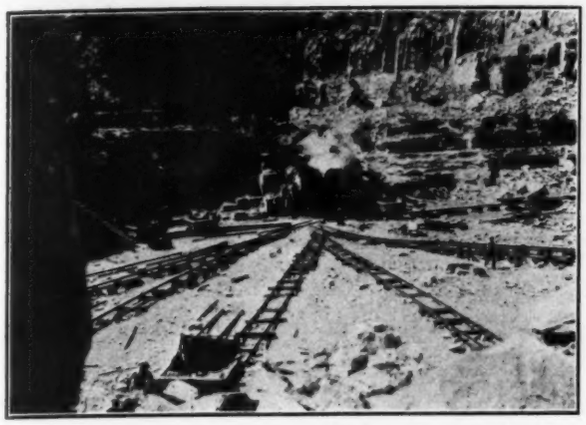
Crushers, Elevators and Screens.

The crushing equipment in the plant consists of the Austin No. 8 gyratory, above referred to, for initial crushing, two Allis-Chalmers No. 5 gyratories for secondary crushing, and a set of Allis-Chalmers 14-inch rolls for fine pulverizing.

The crushers and rolls and all other mill machinery are driven by three-phase, 440-volt, alternating-current motors, the power for which is supplied by the Commonwealth Edison Company's service. The total connected load for the quarry, mill and a limestone grinding plant in this locality amounts to practically 1000 horsepower.

The product of the No. 8 crusher is carried by a short bucket elevator to the feed hoppers of the two No. 5 crushers, by which the rock is reduced to sizes ranging from ½ inch to 2½ inches. This product is raised to the top floor of the mill by a 30-inch bucket elevator, 90 feet from center to center, which discharges to two rotary screens, each 47 inches in

View From Bed of the Quarry, Showing 400-Foot Incline.



View on Bottom Level of Quarry, With Car Approaching Foot of Incline. Pump Station in Center.

diameter, 20 feet in length, and having five 4-foot screening sections. A further classification of the material is made by two similar screens installed on the next floor below, the feed passing through chutes to the second set of screens.

All four rotary screens and the main bucket elevator are operated by a 75-horsepower motor installed on the top screen floor. The motor is belted to a line shaft, from which power is transmitted to the screens and elevators at the different speeds required.

It is found at times that the mill is long on certain sizes of crushed rock, in which cases a portion of those sizes is deflected from the screened product and carried by a belt conveyor to the set of rolls, previously referred to, by which a finer, uniform grade is made for other purposes, such as finishing cement walks, floors and the like. These rolls require a 50-horsepower motor.

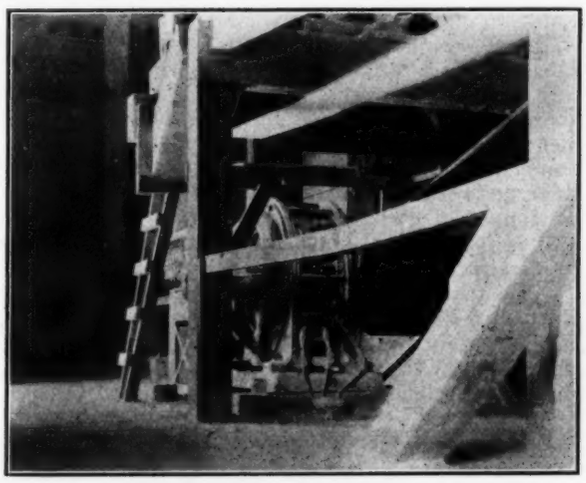
Bins for Truck Loading and Other Features.

The three or four grades of crushed rock for concrete mixtures resulting from screen classification are distributed by chutes to the several big bins immediately below the screen floors. Beneath each set of bins is a driveway whereby auto trucks may be automatically loaded by opening chutes from the hopper-bottomed bins. The company has in use 34 7½-ton trucks for delivering crushed stone where required in any part of the city.

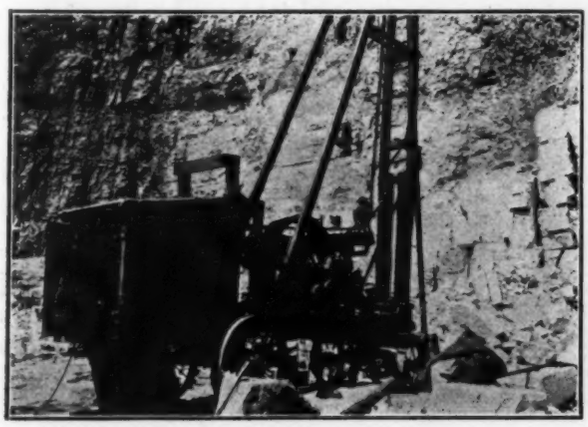
In addition to this and close to the mill, there is a storage platform which is about 100 feet square, capable of giving storage to 15,000 cubic yards of crushed stone. This platform is built upon concrete piers with 10 or 12 parallel driveways below it, so that wagons or trucks may be loaded by gravity by means of chutes from the storage floor. The crushed rock intended for this storage is hauled in mine cars on tracks running out on trestles over the platform to which it is dumped.

It may be noted that the mill is a dry-crushing and dry-screening plant. In the application of electric power to all machinery in this stone-handling plant the belt transmission is employed throughout. Allis-Chalmers equipment is in use in the crushing and screening plant, and the motors are of various types of manufacture. In the quarrying operations all blasting is by electric battery firing, by means of a cap exploder connected to the battery by wire.

The limited area of ground embraced in the property allows extensions in one direction only and that is downward. Evidently, the depth of the quarry, about 275 feet, makes the operation of a steam shovel impracticable for loading cars. However, the quarrying, haulage and crushing facilities are equal to 1000 cubic yards per day.



Typical Motor Drive in Mill.



Motor-Operated 5-Inch Churn Drill Operating in Pit.

WASHINGTON ASSOCIATION OF CONTRACTOR-DEALERS WILL AFFILIATE WITH NATIONAL ASSOCIATION.

The Washington Association of Electrical Contractors and Dealers held its quarterly meeting at Seattle on the evening of June 13. The chief topic discussed was the question of adopting the constitution and by-laws of the national association. A resolution was passed that these be adopted at the next annual meeting to be held at Seattle in September. This means the affiliation of the Washington body with the national association. It was also voted to send a representative to the national association convention to be held in Cleveland on July 15-20. Representatives were present from Spokane, Ellensburg, Yakima, Bellingham, Everett and Tacoma. A special committee is to be appointed to arrange for the convention to be held at Seattle in September. V. S. McKenny of NePage-McKenny Company, Seattle, is president of the Washington organization, with H. D. Allison, Seattle, as secretary.

Better Lighting of Textile Mills

Improved Lighting Aids Present Speeding Up and Prepares for After-War Demands—Intensified Production and Other Advantages—Common Defects—Mill Lighting Requirements

By F. H. BERNHARD

This is the second of a series of twelve articles on improvement of lighting in as many industries. These articles emphasize the desirability of improving industrial lighting to meet present heavy demands and those to come after the war. The benefits of better lighting are set forth in a non-technical way so they may be brought to the attention of factory owners, managers and superintendents, very many of whom still have but an imperfect realization of the importance of good illumination to their industries.

SPEED is the call of the hour to American industry. The more speed we develop now the sooner we shall succeed in winning the war. To win the war is as much the prime business of our big industrial army as it is that of our armed military and naval forces. The enormous supplies required by the latter call for increased output without deterioration of the quality of the product, without very much new investment in manufacturing buildings, and with lessened numbers of skilled and added unskilled workers. All these are features that make the solution of the present industrial problem a difficult one. Anything that aids in its solution should therefore prove of interest to manufacturers and to the nation as a whole.

The textile industry was one of the first to hear the call to speed up. The Government needed several hundred million yards of cloth for soldiers' and sailors' uniforms, for blankets, for tenting, for surgical dressings, for airplanes and other urgent uses. In the way of knitted goods it needed hundreds of millions of pieces of hosiery, underwear, mittens, sweaters, and the like, and although volunteer knitters numbering probably millions of patriotic women aided in this task, the bulk of it fell on established knitting mills whose high-speed machinery alone could meet the demand as to the quantity actually required in the shortest possible time.

Improved Lighting Helps Solve War Problems and Prepares for After-War Conditions.

To meet the situation new textile mills were built and others enlarged, but on the whole it has been found best from all standpoints to secure more intensive and more efficient utilization of existing facilities. This involves operating with two or three shifts per day, running at higher speeds of machines where possible, and eliminating all wastes of time and material in every step of the manufacturing process. Night work,

Fig. 1.—Loom Room in Weave Shed of Henry Doherty Silk Company, Paterson, N. J. Every Part of This Room With Its 200 Looms Is Excellently Lighted.

Fig. 2.—Warping Department, Henry Doherty Silk Company, Paterson, N. J. Three Lamps With Enameled Steel Reflectors Light Every Part of Each Machine, So Each Fine Thread Can Be Seen Throughout the Warping Process.

of course, can be carried on efficiently only under a system of artificial lighting practically as good as the best daylight. But even by day almost incredible losses of time and material occur because of the changeable character of daylight, which on cloudy days and winter mornings and evenings is likely to be inadequate throughout the plant, and in many portions is inadequate even at noon on a bright day. The fact is that efficient work cannot be carried out at any time unless abundant and well directed light is at hand. Many mill owners have recognized this fact and provided excellent illumination with most beneficial results. There are still numerous textile mills, however, where the lighting is far from satisfactory and which suffer a serious handicap on this account.

An improved system of lighting is imperative therefore for overtime and night work, as well as for attaining the highest possible efficiency of production by day regardless of weather or season. As a war measure it is consequently a most timely means of getting the increased production so urgently needed now. But after the war it will be needed no less than now. The best opinion is that the heavy demands of the present will not drop off greatly after the conclusion of peace. The probability of keener competition then will not permit relinquishing the higher efficiency now obtained, rather will there be call for still higher efficiency. The cost of improving the lighting now, while a patriotic expenditure to help win the war, is also a shrewd investment in preparedness for after-war conditions.

The fact of the matter is that good lighting pays for itself not only during an emergency but even under normal conditions. Its benefits are numerous at all times and combine, directly and indirectly, to increase production while at the same time enhancing the contentment of the workers. So important are these advantages that it will be desirable to discuss them a little more in detail.

The principal benefits of improved industrial lighting are as follows:

(1) It reduces accidents to the workers.

(2) It promotes the contentment of the workers and reduces labor turnover.

(3) It reduces spoilage and improves the quality of product.

(4) It increases the production rate and therefore the quantity of product obtained from the same workers and same machines.

Effect of Lighting on Accidents.

"Safety First" as a slogan for both employers and employes has had far-reaching results in reducing the large number of avoidable accidents which have marred the industrial record of this country. A few years ago they averaged about 500,000 a year.

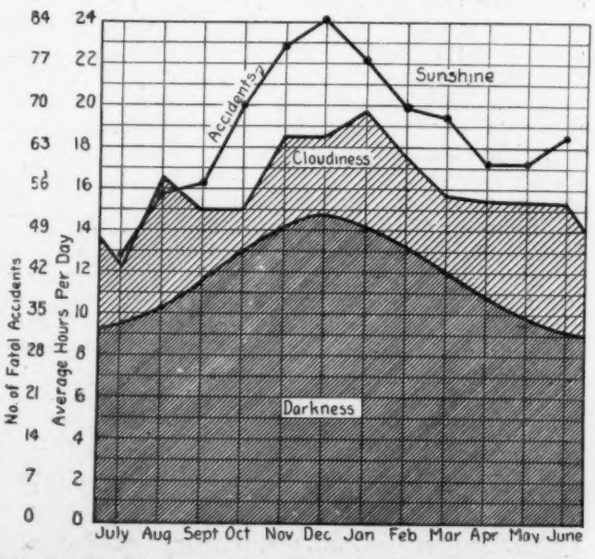

No. of Fatal Accidents
Average Hours Per Day
84 77 70 63 56 49 42 35 28 21 14 7 0
24 22 20 18 16 14 12 10 8 6 4 2 0
Accidents
Sunshine
Cloudiness
Darkness
July Aug Sept Oct Nov Dec Jan Feb Mar Apr May June

Fig. 3.—Monthly Distribution of Fatal Industrial Accidents in New York City in a Typical Year, Compared With the Average Distribution of Darkness, Cloudiness and Sunshine Per Day.

Fig. 4.—Weave Room in Silk Mill of Post & Sheldon Corporation, Allentown, Pa. Colored Silks Being Woven Under Mercury-Vapor Lighting. Colors Are Easily Detected Even Though Greatly Differing From Daylight Values.

The close connection between numbers of accidents and amount of darkness is clearly shown in Fig. 3, which gives the seasonal distribution of fatal accidents and of darkness, cloudiness and sunshine for a typical year in New York City. The same relation holds as to the much more numerous nonfatal accidents. This evidently demonstrates that the absence of bright daylight accounts largely for the increase of accidents, which means that artificial light has not been adequately or properly employed.

The consensus of opinion among industrial safety experts is that close to 25 per cent of all industrial accidents are caused more or less directly by poor lighting. In other words, about 125,000 of the total accidents per year can be prevented by improved lighting. This alone would represent a big saving to the manufacturers, estimated for the state of Massachusetts alone as about $1,000,000 a year, an amount that would be enough to provide a modern system of lighting for almost every factory in the state.

Although the textile industry is by no means as hazardous as several others, such as iron and steel making or coal mining, it is responsible for large numbers of injuries caused by high-speed spindles, shuttles, belts and gears. And aside from the bruises and cuts due to machinery, there are very many accidental falls on inadequately lighted stairways, gloomy passageways, and the like, substantially all of which could be eliminated by proper lighting of these usually neglected places in a mill.

Improved Lighting Means Better Visual Conditions and More Contented Workers.

In textile work nearly all the processes involved, especially spinning, weaving and finishing, require keen eyesight and close visual work by the operatives. Under poor light, whether by day or night, accurate vision is almost impossible and therefore mistakes occur, imperfections go unnoticed, and production suffers both in quality and quantity. But more than that, attempts to do exacting visual work in an improper light, especially if prolonged, result in serious eye strain and fatigue. This has not only physiological effects in gradually damaging the eyesight, but also important psychological effects such as development of a depressing and gloomy attitude on life and things in general in which discontent and ill will toward the employer finds a fertile source.

The general aspect of the workrooms also has an important bearing in this direction. The low, dingy, dirty and unattractive rooms so common in the old mills had an evil influence on the workers that resembled that of the old prison workrooms. Many of the older mills have been modernized by cleaning of windows, liberal use of whitewash, installation of ventilating and sanitary equipment, and the provision of good artificial lighting. The latter alone has had a most wholesome effect in stimulating the efficiency of the operatives and in making the premises cheerful places to work in. Especially noticed is this with the women operatives.

Welfare work among employes is becoming recognized not only as humanitarian and social service, but as having a direct value to the employer in making for greater contentment among his employes. At the present time the great demand for all labor and the difficulty in keeping experienced workers particularly should lead the mill owner to give unusual importance to all efforts that promote contentment. Improved lighting, by relieving eye strain and its attendant worry

and nervous fatigue, and by increasing the cheerfulness of the environment, helps to make the workers satisfied and this aids materially in making them more efficient. A weaver with impaired vision is a liability to a mill just as is the one who is continually changing his place of employment. Therefore good lighting, which eliminates injury to eyesight, is a most timely means of keeping operatives in best working condition and, by helping to keep them contented, is a simple and economical means of overcoming the loss from large labor turnover.

Improvement in Character of Work Through Better Lighting.

The quality of textile products depends not only on the grade of the raw materials used and on the perfection of the looms used in their weaving, but on the skillful manipulation of the threads by the operatives and the sharpness of their supervision over all the steps of the process. To detect an imperfection in the goods before it has developed into a large batch of spoiled product or "seconds" requires keen eyesight on the part of the operatives and suitable illumination to enable them to see without strain of the eyes or nervous system. It is evident that poor lighting makes it impossible or difficult for the operative to see promptly any blemish in the evenness of the weave.

This statement is borne out by the fact that cotton goods made in summer formerly commanded a higher price than those made in winter, because the artificial light available until recently was greatly inferior to natural daylight so that the goods made when artificial light had to be used extensively were necessarily of poorer quality. Marked advances have since been made in lighting cotton mills so that their products are now of substantially uniform quality whether made in winter or summer, day or night. Good lighting has thus had a telling effect in diminishing "seconds" and increasing the value of the product.

Countless outright mistakes are also made because of poor light that are more serious than merely imperfections in the goods. Inability to read a batch order correctly or errors in selecting the proper fabrics or in arranging them as ordered result quite commonly from inadequate or misdirected light. They represent a large part of the annual loss from spoilage, which has been estimated by a textile-mill authority as about 2½ per cent of the entire output. Modern lighting would materially reduce this loss so that it would soon pay for itself on this score alone.

During the past year heavy inroads have been made by the draft on the operatives of textile mills. The owners have consequently had to increase still more the percentage of women employes, which already was large. During the training of new workers specially close supervision must be given to them and they should be afforded every facility to aid them in mastering their tasks, else serious mistakes with inferior output and possibly accidents to the operatives themselves and the machinery are likely to result. This makes the provision of better lighting timely.

How Improved Lighting Increases Textile Production.

It has already been shown that a modern system of lighting reduces accidents, improves the worker's condition and reduces the spoilage of the work done. The better supervision made possible by good lighting also diminishes loafing. Each of these in turn increases the rate of production, either directly through decrease of time and material lost or indirectly through the improved general efficiency of the operatives.

It is obvious that an unskilled operative will take considerably more time to thread a shuttle or set of knitting needles or tie a broken thread when there is poor light than when there is good light, because any ordinary individual finds it more difficult to thread a needle at dusk than at noon. Even a skilled and highly dexterous operative will take less time for these and similar operations under an improved illumination.

But more important even than this is the reduction effected by good lighting in the time loss between automatic stoppage of a loom because of a broken thread and location of that thread. If the operator has to grope around in semi-gloom to find the thread, this means an absolute loss of the productive capacity of an expensive machine. Progressive mill men realize that every minute thus lost is an irretrievable waste

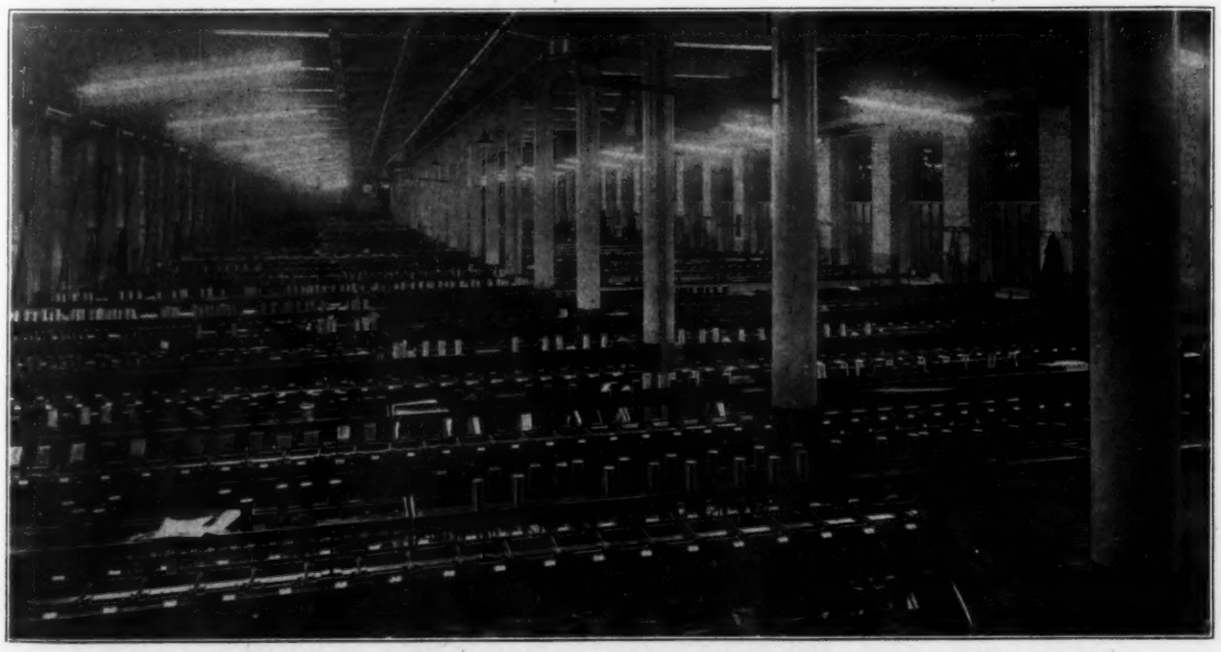


Fig. 5.—Skein Winding in Stehli Silk Corporation's Silk Mill. Uniform Illumination From Two Rows of Mercury-Vapor Lamps.

and every effort should be made to obviate it. The value of good lighting in minimizing this loss is not sufficiently recognized, however.

The extraordinary demand for speed in production as the result of the war has caused some progressive textile mills in the South to speed up their looms as much as 25 or 30 per cent above what was until recently considered to be the maximum safe limit. Although this means shortened life of the machines through more rapid wear and tear, it easily has paid in the increased production obtained from the mill facilities and labor available. To make this increased speed feasible required considerable increase in the illumination so as to make the stoppages a minimum and thus avoid neutralizing the advantages of the higher speed.

The electrical engineer of this same organization emphasizes the fact that as a rule a mill is in actual operation only 8, 9 or perhaps 10 hours a day, whereas the interest and other fixed charges on the heavy investment in buildings and machinery go on for 24 hours a day. Consequently the more intensive use obtained from this investment, the greater is the profit, since the fixed charges and labor cost per unit of output are thereby reduced. It therefore pays to get the utmost out of the lighting equipment by operating it at even higher than rated efficiency, since the added illumination obtained will permit of more intensive production all round.

Another way in which good lighting makes it possible to get increased output from the same investment in plant and equipment is to operate the mill with two or even three shifts per 24 hours. On account of the large amount of machinery used in textile mills the investment per employe amounts to nearly $2000, which is an exceptionally high figure. If the mill is idle 14 to 16 hours a day, this investment is producing only a third or a little over of what it is capable of doing. By double or triple-shift operation the fixed charges are therefore reduced to one-half or one-third. Formerly night operation was considered to be impracticable; in fact, it was almost impossible to get men to work at night; this was chiefly because of the poor lighting available as compared with daylight. With modern lighting equipment it is possible to reproduce daylight conditions very closely and in some respects to surpass them, certainly as to constancy and uniformity of the illumination obtained. That mill work can be done satisfactorily at night is shown by the fact that it not only is done, but in some mills more work is actually turned out per man than by day. Night work is therefore a valuable means of cutting down production cost while at the same time increasing the output for a given mill equipment.

The question may arise, how much increase of output can be obtained from improved lighting? This depends on a number of factors that make an exact answer impossible. Definite data obtained from actual trials are also scarce because of the difficulty of making a fair test wherein no conditions are changed except the lighting. A number of experiences may be cited, however.

A specific answer was obtained in a knitting mill where the piece-work system of payment prevailed. After the installation of improved lighting it was found that the pay envelopes averaged about 8 per cent more than before—conclusive evidence of that much increase in output. In a woolen mill it was reported that the efficiency of the weaving department, whose lighting had been modernized, was increased about 20 per cent. Ten per cent has been reported in many textile mills and may be taken as an average value of the increased output from good lighting.

Low Cost of Good Lighting.

This increased output, together with the other additional benefits already mentioned, is obtainable at an extremely low cost. The total cost of lighting equals

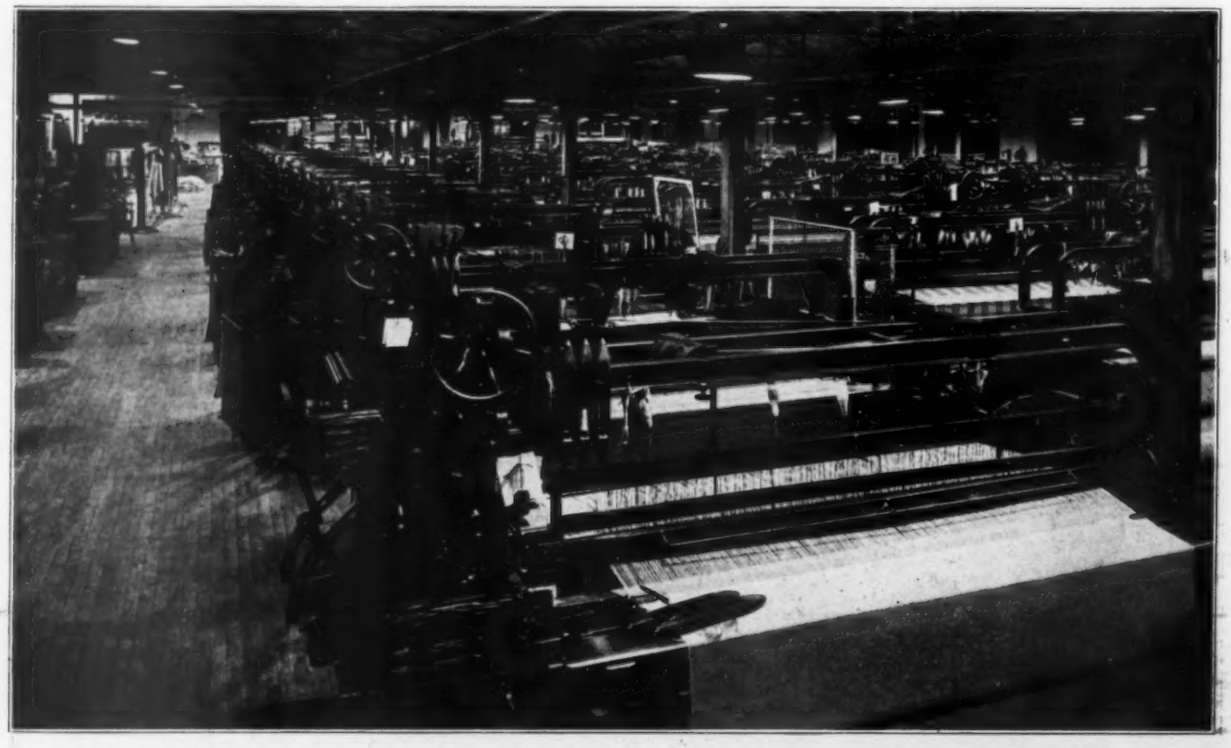


Fig. 6.—Blanket Weave Room, Seymour Woolen Mills, Seymour, Ind. This Illustration From Mazda Lamps Increased the Efficiency of This Department About 20 Per Cent.

Fig. 7.—Weave Room in Republic Cotton Mills, Great Falls, S. C. Glare-Free and Evenly Distributed Illumination by Indirect Lighting Fixtures With Special Glass Covers.

only a fraction of 1 per cent of the wages, estimated in some cases as low as one-tenth of a per cent. Even if it were as much as 1 per cent and the work day were 10 hours, if the lighting saved the operative six minutes a day it would fully pay for itself on this score alone.

In an industry that does not hesitate to replace an obsolete spinning machine or weaving loom if by so doing production can be increased by a few per cent so as to offset the increased investment, it is obvious that the relatively low cost of modernizing the lighting should offer no barrier to rehabilitating it on scientific lines because the increased output and other important advantages thereby obtained will pay for the change in a very short time.

How to Recognize Poor Lighting.

The wide-awake textile manufacturer appreciates the value of good eyesight and good lighting in his industry, but is apt to believe that the lighting he is furnishing is ample for the purpose, especially if he has already made some improvements on it in recent years. A lighting expert, of course, could in a rapid inspection point out manifest shortcomings in the lighting system, but it is desirable that the owner and his superintendent be able to recognize poor lighting both directly from the equipment and illumination and indirectly from the symptoms it shows in the operatives. The most common faults will therefore be briefly mentioned below.

Carbon and Other Obsolete Lamps.—There is practically no excuse for still keeping in service the now obsolete carbon or metallized-filament incandescent lamps, whose inefficiency compared with modern lamps is especially objectionable when all needless waste must be avoided because of fuel economy. Modern tungsten-filament lamps, commonly known as Mazda lamps, furnish three or even more times as much light as the old carbon lamps.

Bare Incandescent Lamps.—A bare lamp is wasteful because it scatters its light indiscriminately in all directions; it should be equipped with a suitable reflector to throw the light where it is needed. A more important objection to bare lamps in the line of vision is that their very bright filaments cause objectionable glare, which produces eye strain and discomfort and also hampers vision by its blinding effect. A properly selected reflector not only increases the efficiency of the unit, but also helps to screen the filament. In cases where the reflection of the direct light of the lamp is objectionable from polished surfaces of needles and other machine parts, special diffusing means should be employed.

Uneven or Spotty Lighting.—This is very commonly prevalent where drop cords are used. The light from low-hung drop lights is confined to a comparatively small zone and outside of it the illumination is relatively low. Even where the brightly lighted zone covers the principal work, the contrast between it and surrounding areas is so great as to fatigue the eye in its effort at accommodation when looking back and forth.

Inadequate Illumination.—By this is meant insufficient intensity of illumination, a very common shortcoming in the older textile mills at least. It results in cumulative eye strain, which shows itself in increased fatigue, mistakes and accidents and slowing up of production toward the end of working periods. This applies to daylight as well as artificial light, many parts of large workrooms receiving inadequate daylight even at noon.

Poorly Maintained Equipment.—Even when the system was well designed and installed, it will be very inefficient if not maintained. This implies lamps and reflectors frequently cleaned, burned out and blackened lamps renewed, broken and missing lamps replaced, and lamps and reflectors properly mated instead of indiscriminately interchanged. Neglect of

Fig. 8.—Knitting Room of Milwaukee Hosiery Company, Milwaukee, Wis. Indirect Lighting Eliminates Glare From Lamps and Knitting-Needle Reflection, While Making a Cheerful Workroom.

these simple attentions can result only in poor efficiency and dissatisfaction.

Enormous advances have been made in the textile industry through adoption of improved machinery from time to time, the scrapping of old equipment having proven advisable because of the increased or better output obtained from the new. Similar big progress has been made in the lighting art, especially in the last 10 years, during which almost startling improvements have been achieved through the development of new lamps, reflectors, fixtures, glassware, etc. In fact, it may be said that lighting has been almost revolutionized in that time in making it much more efficient and much better adapted to the varied illumination requirements met with. And the end of lighting progress has not yet been reached. Therefore, an installation made even as late as 4 or 5 years ago may well repay remodeling so as to obtain the benefits of the latest improvements in lamps and reflectors. It is the opinion of lighting experts that on the average every three years some part of the equipment will merit replacement with profit.

Lighting Requirements in Textile Mills.

Textile mills have fairly definite general requirements as to illumination, although there is considerable latitude as to details. The work done being largely close visual work, the lighting should be as perfect as possible and wherever permissible should closely approach the standard of the best daylight, which is that from the unclouded north sky.

In general, as is the case in any industrial plant, the illumination should satisfy three fundamental requirements given, in the order of their relative importance, as follows:

(1) It should be adequate and suitably directed for efficiently doing the work to be carried on.

(2) It should be free from glare, great contrasts and sharp shadows.

(3) It should be reasonably efficient.

Considerable advance has taken place in the ideas of illuminating engineers as to what is adequate illumination. This is because the higher efficiency now obtainable from lighting equipment makes it feasible to approach daylight intensities and the closer we approach them the more satisfactory are the results.

The following table gives illumination intensities recommended by the engineering department of a prominent lamp works, these values being similar to those in the Ohio Factory Lighting Code.

	Foot-candles at work.
Cotton Mills—	
C—Opening bales, carding, slashing, ring spinning, roving, spooling, lapping, warping, packing, shipping	2 to 4
D—Drawing in, weaving, dyeing	3 to 5
F—Inspecting	10 to —
Woolen Mills—	
C—Receiving, carding, dyeing, twisting	2 to 4
D—Washing, combing, picking, warping, packing, shipping	3 to 5
E—Weaving	4 to 8
F—Inspecting, perching	10 to —
Silk Mills—	
C—Receiving, packing, shipping	2 to 4
D—Quilting, throwing, winding, warping, finishing.	3 to 5
E—Weaving	4 to 8
Knitting Mills—	
C—Napping, packing, shipping	2 to 4
D—Knitting, looping, seaming, finishing, inspecting	3 to 5
All Mills—	
A—Roadways and thoroughfares in yards	0.4 to 0.5
B—Stairways, passages, elevators	0.5 to 2.0

These values are shown graphically in Fig. 9.

The foot-candle used in this table is the common unit of illumination. It is the lighting effect produced upon a surface by a standard candle at a distance of 1 foot. This effect varies inversely as the square of the distance, so that a lamp giving off 16 candlepower uniformly in all directions would produce a uniform illumination of 1 foot-candle at a distance of 4 feet.

Aside from adequacy of the illumination at the work it should be directed so as to illuminate not only horizontal but also vertical surfaces. For this purpose the reflector chosen should have a fairly broad light distribution and not almost exclusively straight downward. Until very recently the deep bowl reflector has been chiefly recommended, but the broader dome re-

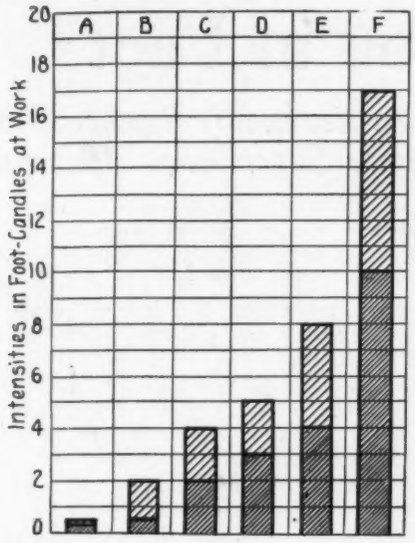


Fig. 9.—Illumination Intensities Recommended for Textile Mills. Based on Factory Lighting Code of Ohio.

flector is now coming into extensive use for this very reason.

The location of the lighting units must be such as to secure the intensity and uniformity desired at the work. This does not mean placing a drop cord over the critical part of a loom that must be most watched and leaving the rest in relative darkness. Modern mill-lighting practice in this regard is to use modified general lighting, the units being placed quite high so as to light every part of the machines and surrounding aisles to a fairly high intensity and spaced a little closer together where it is desired to concentrate more light. No effort should be made to throw all the light down on the work and leave the ceiling and any belts and shafts on it in gloom. Both cheerful atmosphere and safety require that the upper part of the room receive some light from the units, especially if the goods woven are dark and do not reflect much light to the ceiling.

Freedom from glare and its baneful effects calls for one of several means for screening the brilliance of the light source. With the deep bowl reflector extensively used until recently, direct view of the lamp filament was cut off by the edge of the reflector unless one looked at the lamp almost directly from below. The dome reflectors now coming into use because of their improved distribution require use of a lamp, the lower part of whose bulb is frosted or otherwise treated to diffuse the direct rays from the filament. A special form of dome-shaped reflector includes a silver cap that fits snugly over the lamp tip and surrounding part of the bulb and thus cuts off all direct light from the lamps; this is practically an indirect unit and is meeting with favor in mills where directed light is desired with substantially all glare eliminated. By use of semi-indirect units, glare effect is also greatly reduced and by pure indirect lighting it is made a minimum.

Avoidance of great contrasts between the loom and surrounding area is desirable, not only because of the diminished eye strain but also because of safety. Likewise, very dense shadows should be avoided, which means that general lighting and fairly uniform distribution should prevail throughout the room.

The third requirement pointed out above was for reasonable efficiency in the system. Formerly excessive importance was placed on efficiency at the expense of real effectiveness of the illumination. In view of the high efficiency of modern lighting units, it is good practice to utilize some of this for getting better distribution and greater freedom from glare.

No mention has been made in the foregoing regarding the color of the light sources. The fact is that no artificial light source is an exact duplicate of north-sky daylight. It is found that in textile mills, even where delicately colored fabrics are being woven, absolute daylight quality of the light is not necessary. In fact, the mercury-vapor lamp, which of modern sources is the most removed from daylight, is used with high satisfaction in textile mills. Although it distorts colors, it permits detection of different colored threads easily because of the high acuity of vision it promotes.

Only in color-matching and dyeing is true daylight color effect necessary in the illumination. A very close approximation to it can be obtained with the Moore tube or special "true-tint" Mazda lamp.

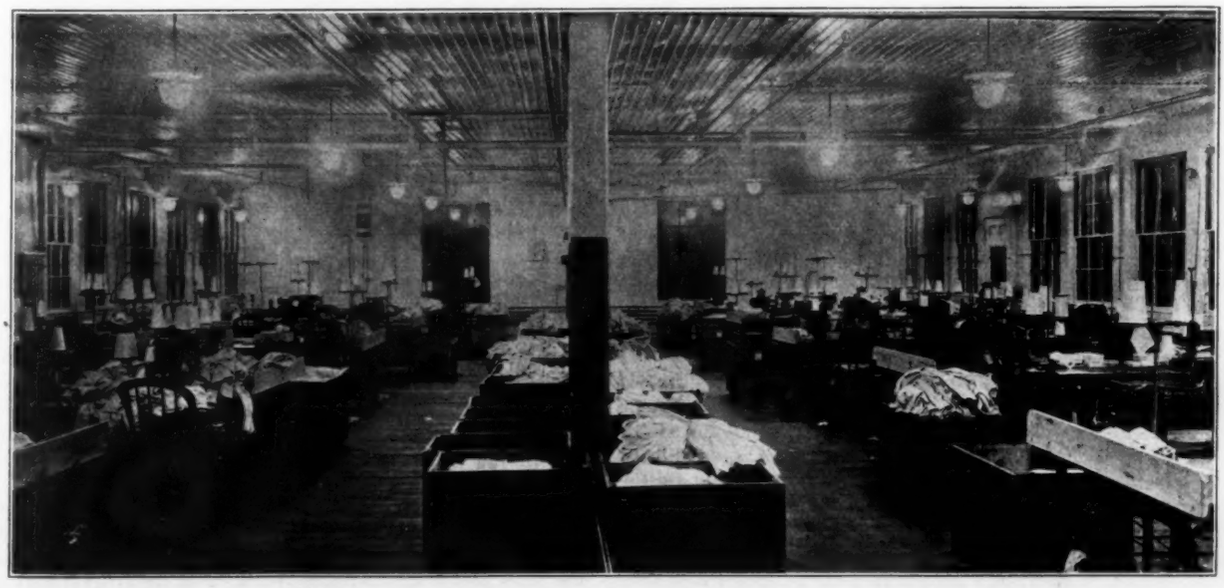


Fig. 10.—Finishing Room, Peerless Knitting Mills Company, Boston, Mass. Semi-indirect Lighting Furnishes Abundant Illumination for Exacting Work.

Coal Conservation in Fact

Coal in Gaseous and Pulverized Form Must Eventually Replace Lump for True Conservation—Federal and State Supervision Advocated

By C. R. KNOWLES

Consulting Engineer.

IN TIMES of stress like the present, when conservation is the great watchword of the day; when the nation has begun to realize the enormous wastes of time and materials which is going on and has been going on for years; when every bit of energy has to be put forth to save in every possible way, the fuel problem looms up as one of the important if not possibly the most important one for present consideration.

In no one way has there been and is there greater waste than in the use of fuel for domestic and manufacturing purposes.

In domestic uses there is hardly any attempt made to obtain anything like efficiency of fuel consumption; the apparatus in the vast majority of cases is inefficient, poorly designed and installed, and the people who have to operate such apparatus are either poorly informed as to the proper way to do so or are careless and lacking in incentive to obtain the best results.

There are thousands of domestic heating installations where the fuel losses through the furnace grate are not less than 25 per cent and very many where the percentage of loss runs as high as 50 per cent. In manufacturing uses it is safe to say that the great majority of boiler furnaces have an efficiency of fuel conversion of less than 50 per cent and when it is considered how vast is the number of varied manufacturing industries, these losses run into astoundingly large figures.

Under present war conditions and the unusually severe weather conditions of the past winter, the fuel shortage became most acute and the public then realized, if never before, the great necessity for an ample fuel supply, and various expedients, such as the limiting or the denying of the fuel supply to various industries deemed by the Government as, for the time being, nonessential; the elimination of the excessive use of illuminants—gas and electricity—for display and over lighting purposes; the setting of the time ahead one hour to conserve daylight, and others, all more or less meritorious but temporary in character, have been and are being used.

All such operations, while they undoubtedly help to tide over and enable a temporary control to be obtained over the existing critical conditions, do not strike at the root of the matter nor are a remedy for the ever present vast fuel wastes which are continually going on 365 days in the year.

These wastes lay right with the consumer, who either does not know of them, or knowing, willfully continues and makes no effort to reduce or eliminate them.

In an editorial in the ELECTRICAL REVIEW, May 25, 1918, entitled, "The First Practical Step Toward Fuel Conservation," it is stated that the remedy for relieving the fuel famine such as occurred during the last winter and which is still with us, "lies in educating those responsible for the plants" consuming coal as a fuel, "as to how best to operate them and insist that they employ means and apparatus for doing it." Further, "those plants . . . should be regulated and their performance controlled by federal, state or civic authorities that the nation's coal supply be not needlessly and wantonly impoverished." "Civic departments for boiler inspection and smoke abatement and allied insurance interests should immediately operate with federal or state authorities to improve these plants where feasible."

It seems to the writer that the ELECTRICAL REVIEW has put its finger on the basic trouble and has indicated the remedy. The aim of every coal user should be to obtain the maximum of heat from a given weight of coal, use less and utilize more.

To do this the users of fuel should be shown where their present methods of utilization are faulty, where changes of apparatus could be made which would cause a betterment, what fuels are best for their use and the best forms in which to use them and how to operate their combustion apparatus with a minimum of cost and a maximum of output. Two points in this connection stand out most prominently: the character of the fuel and its method of application.

It is undoubtedly true that the use of coal in lump form is not its best form of application, and that it is necessary to break up a fuel to such uniform size that the oxygen of the air can unite perfectly with it for combustion, and that the finer it is the more completely it can be oxidized and consumed. As early as 1881, Sir William Seimens said: "I am bold to go so far as to say I consider it barbarous to use coal for any purpose in its crude state and believe that the time will come when all crude fuel will be separated into its component parts before utilization."

A 1-inch cube of coal exposes but 6 square inches, 1/24 of a square foot, of surface area for absorbing oxygen and liberating heat, but when pulverized to a proper degree of fineness it will expose from 20 to 25 square feet of area—500 to 600 times as much area—for oxidation so that the finer the coal is divided the more complete will be the combustion.

That this is true is borne out by the enormous public use of the finer sizes of coal—pea, buckwheat and rice sizes—in furnaces properly equipped for their use and also indicates that ultimately the best and most economical use of coal is in its pulverized form, in which form practically complete and smokeless combustion takes place.

It also follows that the combustion apparatus must be of such a character as is best fitted for the form of fuel used, becoming simpler and more efficient in form the finer the subdivision of the fuel and reaching its ultimate of simplicity and efficiency when finely pulverized coal is used.

ULTIMATE COAL CONSERVATION.

It is the opinion of the writer that the ultimate form of fuel to be used to obtain the best economic results is a gas or a near-gas fuel—gas for domestic use and pulverized coal for industrial uses. To arrive at such a desired condition of economical fuel utilization there is not the slightest doubt but that federal,

state or civic control is necessary, otherwise substantial progress will not be made, because the great majority of fuel users will be satisfied to go on in the old way unless compelled to change, not alone for their own good but for the good of the great majority.

The question of smoke abatement is a fair example of such a condition. So long as there was no compelling authority to cause its stoppage, the public at large continued to make as much smoke as it pleased, regardless of its deleterious effects, but so soon as various states and cities enacted laws regulating its formation and said this nuisance *must* be stopped, a different condition of affairs came about and in very many places the smoke nuisance has been abated and eliminated, and the end is not yet.

That practical steps are now being taken toward conserving the nation's fuel is evidenced by the action of the Fuel Administration in starting a widespread investigation of all steam-making power plants with a view to obtaining data as to their capacity, condition and efficiency, by means of which they will be enabled to instruct plant owners and operators as to the best manner in which to improve their plants and increase their efficiency.

This is a move in the right direction, but it should go farther and investigate the various forms of fuels and their applications and after arriving at definite conclusions as to what is the best for the great majority of fuel consumers, to formulate these conclusions and enact rules and regulations for their enforcement, not drastically, but in such a manner as will cause the least amount of hardship to the individual and ultimately attain the desired result.

The day is past when the nation's fuel may be indiscriminately squandered according to individual whim, and the time is coming when it will be a cause of wonderment that the present laxness and wastes in use of fuels ever existed or was ever allowed to exist.

This is no pipe dream but a stern reality. It means hard, continued and patient work and will take time for its accomplishment, but it can be done, as the writer knows, and will be done, as he feels assured.

THE FUTURE OF BRITISH ELECTRICITY SUPPLY.

Ambitious Reorganization and Extension Proposals.

The discussion of the question of nationalization of electric power supply in the British Isles has been carried a stage further by the completion and publication of the report of the Board of Trade Electric Power Supply Committee. In May, last year, the committee issued a number of preliminary conclusions setting forth that the use of electric power supplied at the lowest possible price formed a highly important element in securing the most efficient methods for industry and the reduction of manufacturing costs. It was recognized that industrial competition in the future would call for increased average output per head with higher wages per worker. Upon these requirements was based the argument against the present system of supply of electricity by many small and separate authorities. It was recognized that however desirable in itself, the inter-connection of existing systems could not alone meet the requirements of the situation, and that a comprehensive system of generation with reorganized supply where necessary, should be established as soon as possible. Since that date a great deal of evidence has been taken, experts of all leading electric supply interests being heard. The national aspect of the matter, the outlook for the future, and many points respecting ownership, operation, organization in new areas, the setting up of commissions and their duties, and so forth, were covered in the course of the investigation. These are fully set forth in the report, and the recommendations advanced are:

(1) That a new body, to be called the Electricity Commissioners, should be set up, to whom should be transferred the existing powers of the Board of Trade, Local Government Board, Local Government Board for Ireland, and Scottish Office, relating to the supply of electricity, and to whom large additional powers should be given for regulating and encouraging the generation and distribution of electricity.

(2) That the Electricity Commissioners should, subject to an appeal to Parliament in certain cases, have general control over the generation and distribution of electricity in the United Kingdom.

(3) That the existing system under which electricity is separately generated for small areas should be abolished.

(4) That the Electricity Commissioners should, after local inquiries, divide the United Kingdom into districts technically suitable for the economical generation and distribution of electricity.

(5) That in each electrical district a District Electricity Board should be set up which should purchase all generating stations of authorized distributors whether local authorities, companies, or power companies.

(6) That the District Electricity Board should be responsible, by themselves or their lessees, for the future generation of electricity in their district and for the establishment of new generating stations and proper systems for the main transmission of electricity in their district.

(7) That existing electrical undertakers should, if they so desire, retain their power of distributing electricity within their local areas, but should purchase electricity in bulk from the District Electricity Board or their lessees, one provision being made for controlling the profits of distributors so as to insure a cheap supply of electricity to consumers.

(8) That District Electricity Boards should make no divisible profits.

(9) That District Electricity Boards should be financed, in whole or in part, by funds raised with Government assistance, except where it is shown to be desirable and practicable to finance the boards locally.

(10) That largely extended powers should be granted for the use of overhead wires, wayleaves and acquisition of water rights.

FRENCH FIGHTERS, KNOWN AS BLUE DEVILS, ENTERTAINED BY EDISON.

The Blue Devils of France, who have been visiting the United States, had the pleasure of being entertained recently at Orange, N. J., by Thomas A. Edison, who spent a part of a day with them. The French fighters were shown through the workshops and laboratories of the great electrician, and allowed to see much that is ordinarily kept from public view. One of the incidents of their visit was the presentation by Mr. Edison of a phonograph, with records for reproducing patriotic songs in English and French. Another feature was a short parade by 7000 Edison workers, led by the Edison band, to an open-air meeting place.

Mr. Edison, at the conclusion of the open-air meeting, entertained the Blue Devils at a lawn luncheon at his beautiful home.

Abstracts of Papers Presented at Institute Meeting

Summary of Engineering and Technical Paper Read at A.I.E.E. Convention at Atlantic City, N. J., June 26-28

AMERICA'S ENERGY SUPPLY.

By Charles P. Steinmetz.

The gist of the paper is to demonstrate that the economical utilization of the country's energy supply requires generating electric power wherever hydraulic or fuel energy is available, and *collecting the power electrically, just as we distribute it electrically.*

In the first section a short review of the country's energy supply in fuel and water power is given, and it is shown that the total potential hydraulic energy of the country is about equal to the total utilized fuel energy.

In the second section it is shown that the modern synchronous station is necessary for large hydraulic powers, but the solution of the problem of the economic development of the far more numerous smaller waterpowers is the adoption of the induction generator. However, the simplicity of the induction generator station results from the relegation of all the functions of excitation, regulation and control to the main synchronous station. The economic advantage of the induction generator station is, that its simplicity permits elimination of most of the hydraulic development by using, instead of one large synchronous station, a number of induction generator stations and collecting their power electrically.

The third section considers the characteristics of the induction generator and the induction-generator station, and its method of operation, and discusses the condition of "dropping out of step of the induction generator" and its avoidance.

In the appendix the corresponding problem is pointed out with reference to fuel power, showing that many millions of kilowatts of potential power are wasted by burning fuel and thereby degrading its energy, that could be recovered by interposing simple steam turbine induction generators between the boiler and the steam heating systems, and collecting their power electrically. It is shown that the value of the recovered power would be an appreciable part of that of the fuel, and that organized and controlled by the central stations, this fuel power collection would improve the station load-factor, give the advantages of the isolated plant without its disadvantages, and produce a saving of many millions of tons of coal.

METHOD OF SYMMETRICAL CO-ORDINATES APPLIED TO THE SOLUTION OF POLYPHASE NETWORKS.

By C. L. Fortescue.

In the introduction a general discussion of unsymmetrical systems of co-planar vectors leads to the conclusion that they may be represented by symmetrical systems of the same number of vectors, the number of symmetrical systems required to define the given system being equal to its degrees of freedom. A few trigonometrical theorems which are to be used in the paper are called to mind. The paper is subdivided into three parts, an abstract of which follows. It is recommended that only that part of Part I up to formula (33) and the portion dealing with star-delta transformations be read before proceeding with Part II.

Part I deals with the resolution of unsymmetrical groups of numbers into symmetrical groups. These numbers may represent rotating vectors of systems of operators. A new operator termed the sequence operator is introduced which simplifies the manipulation. Formulas are derived for three-phase circuits. Star-delta transformations for symmetrical co-ordinates are given and expressions for power deduced. A short discussion of harmonics in three-phase systems is given.

Part II deals with the practical application of this method to symmetrical rotating machines operating on unsymmetrical circuits. General formulas are derived and such special cases, as the single-phase induction motor, synchronous motor-generator, phase converters of various types, are discussed.

THE AUTOMATIC HYDROELECTRIC PLANT.

By J. M. Drabelle and L. B. Bonnett.

The automatic hydroelectric generating station of the Iowa Railway & Light Company at Cedar Rapids, Iowa, is a radical step in advance in the elimination of operator's wages in a station of appreciable size, without sacrificing complete control.

This station consists of three 400-kilowatt, 500-kilovolt-ampere, 60-revolution per minute, 2300-volt, vertical generating units, tied in to a system, of which the main generating station contains about 20,000 kilovolt-amperes in steam turbo-generators. One striking feature is the entire omission of the usual governors, the waterwheel gates being motor driven and controlled by contact-making ammeters. Each unit has its individual control panel, consisting of the necessary contactors and relays to connect it to the bus at the proper time. A motor-driven drum controller gives the proper time element between the different steps in the operation of placing the generator on the line. Any generator can be started either by a float switch when the pond level reaches the proper height or by a remote control button in the steam station. The starting of the first generator throws on the line the motor of one of the two exciter sets, and the generator cannot be connected to the bus until the excitation voltage has reached the normal value. The waterwheel gates are then partly opened and the generator comes up to approximately normal speed. It is then connected to the bus without field through an iron-core reactance. Then a weak field is applied. Next it is raised to full normal value, and then the reactance is short-circuited. The contact-making ammeter opens the gates to full gate opening and the generator then carries full load in about 40 seconds after either the control button is closed or the float switch is closed.

SUSTAINED SHORT-CIRCUIT PHENOMENA AND FLUX DISTRIBUTION OF SALIENT-POLE ALTERNATORS.

By N. S. Diamant.

It has been found that the ordinary theories of armature reaction or short-circuit impedance tests do not give the wave-forms to be expected. In the present case a detailed analysis has been made of sustained short-circuit phenomena, with particular attention to the question of flux distribution under such conditions. And by taking proper account of certain details and secondary effects the complicated phenomena of sustained short-circuits can be explained.

It seems fair to conclude that the sustained short-circuit phenomena of alternators are amenable to the theories of synchronous machines already advanced by Blondel, Potier and others. Unless the field and armature flux waves are sinusoidal the resultant field under sustained short-circuits will be badly distorted. The magnetic oscillations under load, no-load and sustained short-circuit are studied by full-pitch exploring coils placed on the rotor and stator, and also concentrated coils placed on top of a wedge or a tooth and having a pitch equal to a slot-pitch or fraction thereof. The principal observations observed were those due to the teeth, oscillations due to the eccentricity of the rotor, oscillations due to armature reaction, and oscillations due to the pulsations of the magnetic reluctance caused by the salient-pole construction of the machine.

It is found that there is little difference in the phenomena with the different forms of short-circuits and the alternator connected Y, Y with neutral closed, and delta. Attention is drawn to the bearing of the results given in the paper on what are considered standard methods of testing large alternators. The thorough understanding of the underlying facts and the collection of quantitative data on the subject

for salient as well as non-salient pole generators will throw a great deal of light on efficiency tests, cyclic heat run tests, short-circuit load loss tests, phase-shifting or feeding back method of load tests, etc. In such tests the flux distribution and the flux density at different points of the magnetic circuit is of considerable importance. It seems to the writer that, in such cases, even if it be extremely difficult to devise tests and means of predetermining by calculation certain characteristics of the machine, without actually loading it, it is very desirable to know and understand, as well as possible, the internal reactions so that proper rational allowances may be made. In any case, the detailed analysis of these phenomena seems to be a step in the right direction.

PROTECTION FROM FLASHING FOR DIRECT CURRENT APPARATUS.

By J. J. Linebaugh and J. L. Burnham.

The equipment developed for the protection of direct-current apparatus as described in this paper is applicable to all direct-current apparatus and all methods of operation. Special means of protection for use only with particular apparatus or conditions of operation have not been mentioned. The principal steps in the experimental development of high-speed circuit-breakers and flash barriers are briefly given.

The protection afforded by the high-speed breaker or barriers is sufficient for most apparatus and service, but *complete* protection for *any* direct-current apparatus and service requires both the high-speed breaker and flash barriers. Attention is directed to the importance of arranging the connections to the brush rigging so that the magnetic action on the arc will be a minimum, and properly directed, so the flash will do the least damage.

AERIAL CABLE CONSTRUCTION FOR ELECTRIC POWER TRANSMISSION.

By E. B. Meyer.

This paper deals with the problem of supplying high-tension electric service where conditions do not permit of the use of open wire or underground circuits.

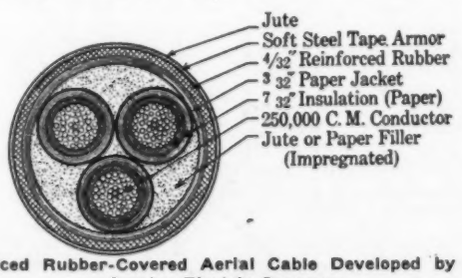
The methods of overcoming difficulties incidental to providing for high-tension service are discussed in detail, together with a description of the types of cable used and methods of installation.

One of the special methods adopted by the Public Service Electric Company in meeting war time demands, was that of furnishing the customer with primary service by the use of aerial cable run on poles and supported by messenger wire, a type of construction similar to that used in telephone work.

This type of construction was first used by the company about seven years ago when it was found necessary to connect two large generating stations through tie feeders.

The matter of running overhead wire was considered but found impracticable because the line in several places would have to cross freight yards, trestles, and bridges, and the owners of these structures objected to open-wire high-tension lines.

Most of the section between these two stations was soil of a marshy character, through which it would have been im-



Reinforced Rubber-Covered Aerial Cable Developed by Public Service Electric Company.

possible to run a duct line without the use of foundation piling.

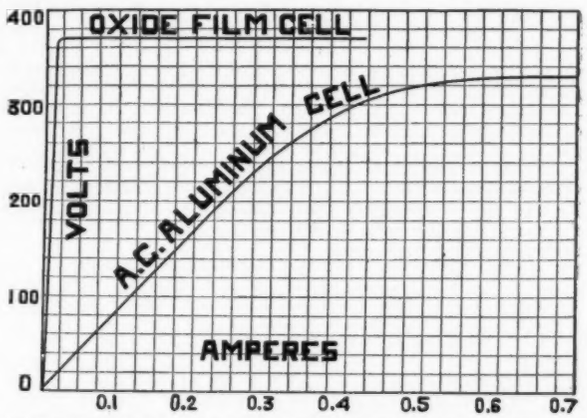
It was, therefore, concluded that the use of aerial cable furnished the most satisfactory solution of the problem. In this installation ordinary lead-covered cable of the same type as that used for underground work was run on a pole line with 50-foot pole spacing. To protect the sheath from mechanical injury there was applied a covering consisting of several layers of jute and marlin with an outer armor of soft steel tape.

The use of lead-covered cable for aerial work was found undesirable, however, because of the excessive weight of the cable and the fact that it could not be installed on standard pole line construction, and a special form of cable was developed to overcome these objections. This cable is illustrated herewith.

THE OXIDE-FILM LIGHTNING ARRESTER.

By Crosby Field.

The oxide-film arrester is a new type of lightning arrester invented by the author and made up of a film of in-



The Comparative Volt-Ampere Characteristics of the Oxide Film Cell and the Alternating-Current Aluminum Arrester Cell.

sulation in contact with a conducting powder. Upon the application of over-voltage, the insulation will be pierced, but the powder will very rapidly turn into insulation and plug any holes punctured in the original insulation by the overvoltage, thus forming in substance a resealing insulation. A brief description of this arrester is given together with the principles underlying its action and a comparison with other types of lightning arresters. It is stated that one of the objects of the development of this arrester was to decrease the cost of manufacture and it was found with the new principle involved in the oxide-film arrester, where the powder furnishes the film rather than the plate, that the aluminum could be replaced by a cheaper metal, such as steel, and, as already described, the initial film known in the early stages of development as the "paint skin" type could be furnished by a layer of varnish. On first sight, knowing the extreme thinness of the hydroxide film on wet aluminum cell it might not seem that the dry cell would give the same general characteristics as the wet cell. But a comparison of the volt-ampere curves shows the same general characteristics. For alternating-current voltages of 300 volts average per cell the current in the dry cell is of negligibly small value up to 40 milliamperes. The power factor is nearly unity and the current flow is due to very slight leakages through the films. In the case of the aluminum electrolytic cells there is an equivalent condition, the direct-current leakage current of the order of one milliampere being due to leaks through the hydroxide film. In the alternating-current aluminum arrester the leakage current on the plate area used is much greater, due to the destructive action of the alternating current on the hydroxide film. Mention is also made of other characteristics of this combination which are not used in the present arrester, but which are being applied in other development. A few notes of tests on the commercial arrester complete this paper. With the exception of the basic patents issued to the author this is the first time any disclosure has been made of this arrester.

THE OXIDE FILM LIGHTNING ARRESTER.

By Charles P. Steinmetz.

A short history of lightning protection of electric systems is given, as relating to the three successive types of electric circuits; the communication circuits, the power circuits of negligible electrostatic capacity, and the high power circuits containing distributed capacity and inductance and capable of electric oscillation, leading to the three problems of discharging over-voltage to ground, opening the power cur-

rent which follows the discharge and discharging so that no power current follows even for a fraction of a half wave. It is shown that these problems are solved by the spark gap to ground, by the use of non-arcing metals in the multigap arrester, which opens the circuit at the end of a half wave of current, and by the so-called "counter e.m.f." type of arrester, represented by the aluminum cell and the oxide film arrester.

It is shown that the necessity of taking care of recurrent discharges in high-power systems had led to the universal adoption of the aluminum cell arrester in such systems, in spite of its disadvantage of requiring daily attendance in charging, and of containing an electrolyte and oil.

In the oxide film arrester a type of arrester is presented which has the same characteristics and therefore the same advantages as the aluminum cell arrester, but does not require daily attendance and contains no liquids.

Its method of operation is explained, and its difference from the aluminum cell arrester; the dielectric film, which punctures under the discharge, and reseals after the discharge, is formed from the solid materials between the terminal plates, compressed PbO_2, and therefore no spontaneous chemical action occurs which dissolves the film, as in the aluminum cell, in which the film forms from the aluminum electrode, gradually dissolves, and therefore requires daily charging.

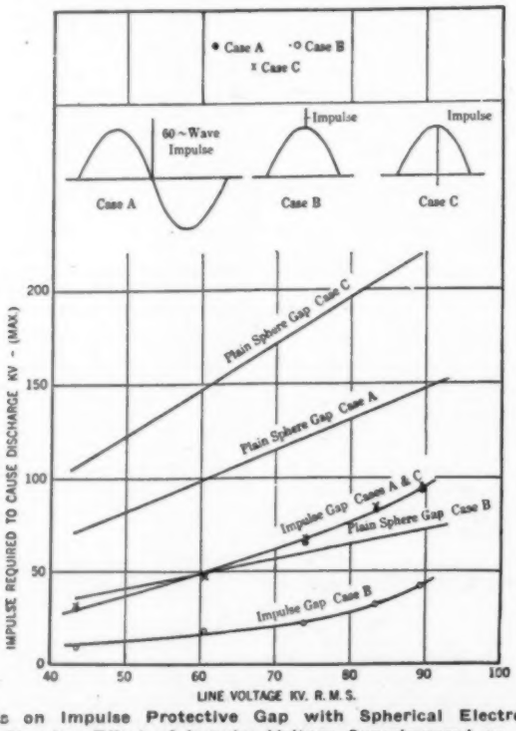
A short description of the construction of the oxide film arrester is given, a record of its operation in industrial service for over three years, and oscillograms showing the performance of this arrester under recurrents, oscillations and under high-power impulses.

LIGHTNING ARKESTER SPARK GAPS.

By Chester T. Allcutt.

This paper describes a new form of high-voltage lightning arrester gap which has been called the "impulse protective gap" because of its particular effectiveness in protecting against line disturbances of steep wave front.

The paper opens with a brief resume of some of the results of previous investigations of the subject of impulse voltages. A discussion of the points involved in securing adequate protection against transient voltages of steep wave front follows. Particular reference is made to some of the conditions that may exist when a high-frequency impulse is superimposed on a low-frequency wave. In this connection is shown the desirability of a gap having a selective action, making it sensitive to steep wave fronts, and a number of forms of gap having this selective property are described.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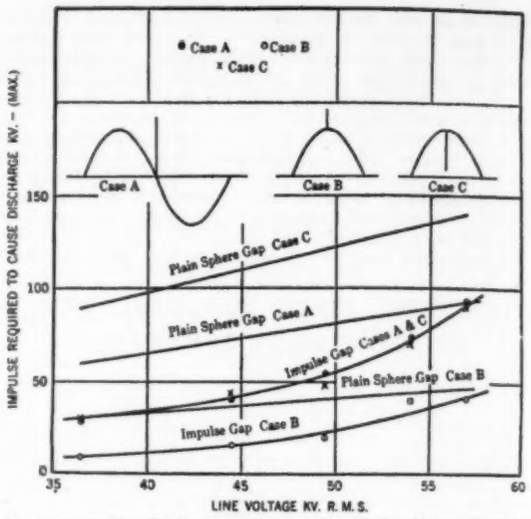
Plain Sphere Gap Case B
Impulse Gap Case B
IMPULSE REQUIRED TO CAUSE DISCHARGE KV. - (MAX.)
LINE VOLTAGE KV. R. M. S.

Tests on Impulse Protective Gap with Spherical Electrodes Showing Effect of Impulse Voltage Superimposed on 60-Cycle Wave—Gap Set at Twice 60-Cycle Voltage to Ground.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Plain Sphere Gap Case B
Impulse Gap Case B
IMPULSE REQUIRED TO CAUSE DISCHARGE KV. - (MAX.)
LINE VOLTAGE KV. R. M. S.

Tests on Impulse Protective Gap with Plain Horn Electrodes Showing Effect of Impulses Superimposed on 60-Cycle Wave—Gap Set at Twice 60-Cycle Voltage to Ground.

Methods employed in testing these gaps are described and the results of a large number of experiments are tabulated. Tests on the action of a high-frequency impulse combined with a 60-cycle wave are included in the experimental work. From the experimental data a number of curves are plotted showing the discharge characteristics of the impulse protective gap under many different conditions.

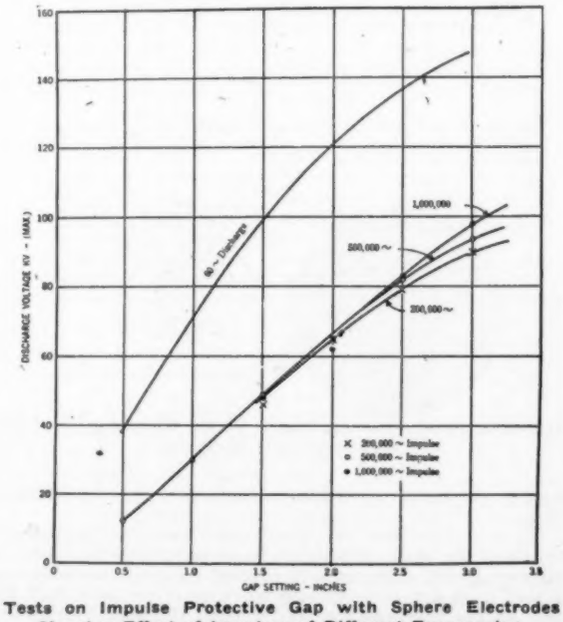
The results of the tests are highly favorable and indicate that the new gap may have a wide application in the field of lightning protection.

APPLICATION OF THEORY AND PRACTICE TO THE DESIGN OF TRANSMISSION LINE INSULATORS.

By G. I. Gilchrest.

The paper first gives a summation of the items that are apparently the main causes of pin-type insulator failures in service. Each item is thereafter briefly discussed and the opinions of operating men are cited.

A brief description is given of the method used to determine the form of the dielectric field about porcelain insula-



Tests on Impulse Protective Gap with Sphere Electrodes Showing Effect of Impulses of Different Frequencies.

tors under normal line voltage. Diagrams of the dielectric field and photographs of flash-over tests of theoretical designs are shown. Thereafter, the necessary modifications of the theoretical designs, in order to meet operating and manufacturing conditions, are discussed.

In the latter part of the paper diagrams and illustrations are shown of a proposed type of commercial insulator design which has been evolved by linking together the theoretical and practical phases of the problem. A comparison is then made between the older types of design and the proposed type, as regards the resistance of each to the conditions that cause failure of the insulator in service.

In conclusion, a summary is made of the advantages it is believed that the new type of design has over the present commercial insulator designs. These advantages are as follows:

(1) When the insulator is dry, the corona and static formations are practically limited to the tie wire and line wire up to flashover voltage.

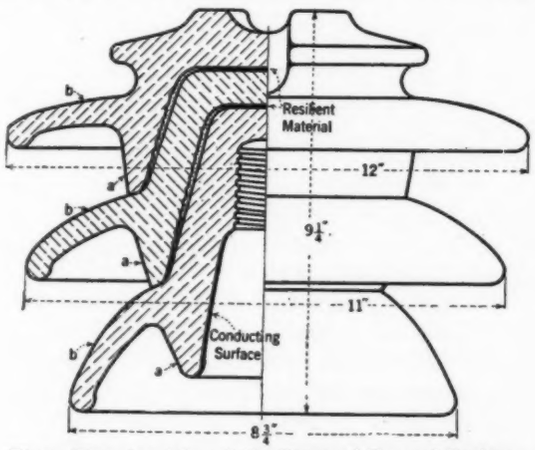
(2) When the insulator is wet, no corona or static formation occurs up to flashover voltage. The flashover voltages for given over-all dimensions are thereby increased.

(3) The leakage resistance per shell is increased gradually from the head to the center shell. This takes into account the probability of the lower sheds becoming dirtier than the top. The voltage distribution per shell is, therefore, equal when the insulator becomes dirty and wet and a heavy leakage current passes over the insulator.

(4) Since the capacity per shell is about equal, the voltage distribution per shell will be equal when the insulator is clean and in dry air.

(5) Since the distribution of voltage per shell depends upon the capacity current and leakage current, the distribution of voltage per shell in these designs should be approximately equal under all operating conditions.

(6) The resistance of the insulator to side pull for a given weight and given electrical strength is relatively high.



Three-Piece Insulator of the Proposed Type of Design.

This is due to the feature of the design whereby the flow line *a* of the electrostatic field and the mechanical stress lines coincide.

(7) The design of the individual shells is such that when they are tested before assembly the surface conforms to the electrostatic flow lines *a*. This allows testing of the individual parts to a higher percentage of service voltage than was possible in case of the individual shells of older designs.

(8) Due to the shape of individual parts and of the assembled unit, the insulator sheds when hit by stones, rifle balls, etc., do not break beyond surface *a*. The unit, therefore, offers a considerable percentage of its original resistance to flashover after the sheds are broken. The same feature tends to protect the insulator from complete failure during flashover in service.

(9) Each characteristic of the insulator which would vitally affect durability in service has been treated uniformly throughout the line.

PRE-CHARGED CONDENSERS IN SERIES AND IN PARALLEL.

By V. Karapetoff.

A condenser is charged from a source of direct voltage, and then is used as a booster in series with this source to charge another condenser. By repeating this process a large number of times the second condenser is finally subjected to twice the voltage of the source. This is the principle of the Delon apparatus for testing cables, and is explained in a numerical example. Then the more general case of two or more "pre-charged" condensers in series is considered, when these condensers are connected to some source of direct voltage; it is shown how to determine the final distribution of voltages among them. A similar problem is solved for pre-charged condensers in parallel. Finally a general network of pre-charged condensers is considered, and equations are derived similar to Kirchoff's laws, from which the final distribution of voltages and charges may be computed knowing the initial distribution.

INCREASED HYDROELECTRIC DEVELOPMENT IN FRANCE.

War Leads to Much Greater Use of French "White Coal" for Its Industries.

One of the good results of the war is that it has aroused throughout France intense industrial activity, and consequently brought about a considerable increase in electric power works, formerly scarce in that country. In 1904 they numbered 1173, only few of which were over 10,000 horsepower. By utilizing the great hydraulic forces of the region of the Alps, power was supplied to the works in 10 departments, covering an area of about 22,000 square miles. The rivers Isere, Arve and Durance form resources which are turned to good account by 12 hydrometallurgical companies representing a total of 180,500 horsepower. During 1914 various plans for utilizing other waterfalls were being considered. Electrometallurgy has been rapidly improving during the war, as well as chemical manufactures, so most of the plans made for development in these industries have either already been carried out or are now in course of execution.

The manufacture of large-caliber shells and armor plate is assured by the help of water power. Thanks to the facilities that the transmission of electrical power offers, the works which undertake to produce it can combine the power of the water descending from the glaciers, very plentiful in summertime, with the force to be obtained from the waters of the rivers, which are swollen by the snow falls of autumn and winter. Such is the system as a whole adopted by the Société de l'Energie Electrique du Centre, which supplies electric power to the towns and factories of the Loire, the Haute Savoie and the Allier, and exceeds 20,000 horsepower.

Before 1914, factories were scarce in the southwest of France. One of the remarkable results of the war will be the industrial activity produced in the regions of Languedoc, Gascony and Guyenne, which indirectly causes the development of electrical power works and enterprises. The Société Pyrénéenne d'Energie Electrique has seen its business amongst manufacturers increase vastly since hostilities began. Its resources comprise more than 50,000 horsepower, obtained from the water from the lakes and rivers of the Pyrenees Mountains.

These new factories, fitted with the most modern appliances, and whose capital, to a large extent, will be covered by war profits, will after peace is restored be called upon to play a considerable role in the economic struggle of the future. They will enable France to become a large producer of materials for which Germany had formerly almost exclusively held the monopoly in manufacture, such as chlorine, bromine, magnesium and products required in the dyeing industries. They also allow of very great economy in coal, and will become a fresh source of inexhaustible wealth and prosperity for the country.

Editorial Comment

The Fuel Administration's Orders

IN THE several discussions of the fuel situation before the recent convention of the National Electric Light Association at Atlantic City, the representatives of the Federal Fuel Administration rightfully asked for the co-operation of central stations, not only insofar as their own uses were concerned but also in aiding in conserving the supply among other coal consumers in the communities served. It was brought out that the Fuel Administration would furthermore expect central-station companies to act as volunteer members of the administration and curtail the supply of power to non-war industries already using purchased energy and refuse connection to the non-war industries making application for service.

It is manifestly right and proper that industries using central-station service should not receive their full requirements of power, while the industries operating isolated plants should be denied coal by the Fuel Administration, assuming, of course, that both classes are not engaged in war work. But it should be remembered that in practically all states utilities are prohibited by franchise or public service commissions from discriminating in the supply of energy and are therefore not permitted by law to give the co-operation that the Fuel Administration so obviously requires.

Here is a situation that requires and deserves prompt congressional action so that the President may delegate to the Fuel Administration the power to regulate the rationing of service. As pointed out by Alex. Dow, president of the Detroit Edison Company, central stations are anxious to co-operate with the Fuel Administration but are handicapped by restraining municipal ordinances and state laws.

Utility interests, through their national committees, should continue to bring these facts to the attention of Congress so that speedy relief may be had.

The Movement to Curtail Residence Lighting

IF PRESS reports from Washington are to be believed, effort is afoot to curtail the use of gas and electricity in the home, and thus save coal, by limiting the monthly consumption to 50 per cent of that for the corresponding periods last year. This savors of a similar law recently initiated in England, for certain sections of the country far-removed from sources of coal supply.

This would be a foolish piece of legislation, if it ever came to anything, which we indeed doubt. To begin with, the saving of coal and the reduction of gas and electricity permit of very small reduction in the average home without radical departure from orthodox home life; secondly, enforcement of such a law would be difficult, and probably cost more than would be saved, a condition, obviously economically unsound; thirdly, such a saving is unnecessary.

Lighting in the average home needs improvement rather than the reverse. Lighting exerts a powerful influence upon the health and comfort of the individual, upon the restfulness, domesticity and happiness of home life, and upon eyesight and the conservation of vision. Good lighting is an important factor in domestic and home life, psychologically and morally, and physically therefore. Efficiency of the individual in the world's work, and therefore of the entire nation, must begin in the home. Preparedness, likewise, begins in the home, preparedness for the battles of life, and the parts played by men and women in the affairs of the world are ultimately affected by the home conditions and influences indiscriminately. To curtail by fifty per cent the light and warmth in the home is to strike a blow at the homes of the nation.

On the other hand electricity consumption in some homes, can doubtless be reduced without doing harm. Assuredly electric light and power is wasted in some cases, though we believe in only a small minority. Porch lights, piano lights, ornamental units scattered about for aesthetic rather than the utilitarian reasons, the continued use of lights not needed, and so on, these wastes can be dispensed with.

But before commencing to do away with lighting in the home, which, per se, might be classed as essential, why not do away with the needless lighting of the obvious non-essentials such as exist almost everywhere outside the home. The saving would be larger, the objections to it fewer, and results would be more easily accomplished. Disallow the lighting of the exteriors of theaters and exhibitions during daylight; forbid dazzling illumination of store windows; stop the supposition of ornamental lamp clusters by progressive merchants where sufficient city street lighting already exists.

Start a move afoot to save electricity and gas in the home by all means. But let it be done wisely and effectively. To order a reduction in consumption of 50 per cent that of the past year is as ridiculous as it is unwise, and almost as impractical. Let saving come by national appeal—we are all of us with the President from first to last for winning the war in the shortest time—backed up by co-operation by the utilities who know their customers' loads, number of outlets, types of lamps, and so forth. Let's all save but let the saving be wise.

There are other aspects of this case. While the fuel cost may be from 30 to 60 per cent that of energy

for the large bulk consumer, it will be nearer 4 to 6 per cent for the residence consumer. Less lighting in the home means less comfort for the family, and also less income for the central station. The saving would at best be small. In any case it would be expensive, expensive for the family and home life, costly to the utility and disadvantageous to the nation.

American Institute of Electrical Engineers' Convention

THE thirty-fourth annual convention of the American Institute of Electrical Engineers, held this week in Atlantic City, is the second annual convention held by our national technical electrical society since the advent of this country in the world-war. Judging by the ambitious program, and the keen attendance, the Institute has lost nothing of its ability to contribute to the advancement of science and progress in applied electrical science, and this notwithstanding that more than 10 per cent of its members are in the national service. Not a war convention in the strict sense, the effect of the war makes itself apparent in the program of papers, and it is easy to understand why the efficient utilization of power and materials, the use of automatic instead of manual methods of control, and so on, have been the keynotes of the majority of papers.

President Rice's address was a masterly review of the electrical engineering progress of the time, in which the improvement of electricity generation from fuel was given a deservedly prominent place. The many advantages of interconnection were clearly pointed out and it was shown that its extensive development during the past year has proven of very timely benefit to the country. As in his midwinter convention address, Mr. Rice also showed how railroad electrification would relieve our transportation problems and promote economy in fuel.

Lightning, in its broad sense, is often with us, attacking aerial conductors by direct stroke or induced charge, going into the underground from the overhead or causing oscillations and the piling up of impulse waves according to atmospheric conditions on the one hand and on constants of the load and circuit on the other. Lightning, so-called, may thus occur from without or within, hence protection from one or the other or both is a necessary part of most systems. The oxide-film arrester discussed at the convention appears to be a radical improvement over the older type of aluminum arrester. To have eliminated the necessity for frequent periodic charging of the new type is an immense stride in arrester design, and one that should hasten the day when better protection is obtainable for isolated apparatus and lonely exposed stretches of line.

Insulation has always been a subject inseparably linked up with electricity. From the first, electrical problems have been ones of insulation, and so they remain today. Developments appear so fast that the insulation problem, apparently solved, has to be solved again, because of higher voltages, placing indoor apparatus outdoors, higher energy densities and resulting higher temperatures therefore, and so on. Insulator design has changed from the cut and try to an efficient blending of theory and practice, so that today the design of insulation, whether for an insulator, bushing or high-voltage cable, is an almost exact science, a new science that uses fundamental laws.

Inductive interference, long a bugaboo, might be expected to make itself more prominent with the coming of interconnection upon a wider scale, the tying in of systems and plants of different wave-form, the use of single-pole air-break switches, the ramification of rural transmission and distribution lines and expansion of vast networks. A paper on this subject rather shows, and it is a welcome sign, that telephone companies are recognizing that responsibility for eliminating interference of small-current low-voltage circuits by the heavy-current high-voltage circuits should be mutual in fairness to the former, and must be so if interference is to be mitigated.

It has been said we will blast Germany out of French and Belgium soil, and this can only be done in reasonable time by the production of vast quantities of nitric acid and ammonia. It is from nitric acid that smokeless and black powder, picric acid, trinitrotoluol and ammonium nitrate are made, and they are needed in vast quantities. And one of the simplest ways to make nitric acid is by fixation of the atmosphere, a process requiring large quantities of power. The needs of this process, told by an Englishman, whose country's needs are our needs, but whose country is far less favorably situated than ours, is an interesting contribution to war subjects and emphasizes our responsibility.

Our vast latent resources, the shortage of power during the last year and one-half and the fuel situation even as it is today makes a serious consideration of husbanding our power supply of vital importance. Our two major natural resources, the black and white diamond, are the alpha and omega of national supremacy, for ore deposits are worth little without the wherewithal to utilize them. And with the coming of conservation of our water powers by efficient usage will come the automatic hydroelectric plant that enables the chief item of operating expense of the small-capacity installation, namely, attendance, to be eliminated.

These are only some of the subjects covered at the convention, that embraced a program as ambitious as it was important. And throughout can be found the blending of the college professor, operating engineer and manufacturer, a combination that for many years has been largely responsible for the wonderfully rapid progress made in applied electrical science.

Altogether, the thirty-fourth annual convention of our national electrical society has proved an immense success, rich in contributions to our knowledge of science, as such and applied, and commendable for its aims and accomplishments.

Week's Events

American Institute Holds Annual Convention—War Problems Discussed at Atlanta—Electrical Contractors to Meet

AMERICAN INSTITUTE MEETS AT ATLANTIC CITY.

Discussion of Engineering Problems Relating to War Conditions Draws Large Attendance.

While the program for the thirty-fourth annual convention of the American Institute of Electrical Engineers, held at Atlantic City, N. J., this week provided for the usual array of interesting papers on technical and engineering subjects, there was never a meeting that was more closely related to our everyday war problems or that demonstrated so forcefully the oft-repeated statement that this is a war of engineers. President E. W. Rice, Jr., in his remarkable address on Wednesday morning, sounded the keynote of the situation when he stated that the engineer is the hope of the nation, not only now, when we are at war, but even more so in the future—in the days of reconstruction following the great peace.

The meeting was devoted largely to a discussion of the engineering problems confronting the central-station industry, since it is upon the solution of these problems that the adequate and continuous supply of power depends.

The convention included six technical sessions and an informal reception and dance on the evening of the first day and conferences of Institute officers and section and branch delegates at luncheon each day from 12:30 to 2:30 p. m. President Rice called the first meeting to order at 10:30 a. m. on Wednesday with approximately 250 delegates in attendance. Chairman J. F. Stevens of the Convention Committee made some announcements regarding the program and Mr. Rice then delivered the presidential address, which was without question the outstanding feature of the convention. Following this address, which was listened to with the closest interest and enthusiastically applauded, Comfort A. Adams, president-elect, was introduced, and in a brief address pointed out that the future activities of the American Institute should be extended and readjusted and its vision perhaps widened following our winning of the war.

President Rice's address, slightly condensed, was as follows:

Address of President Rice.

The progress of the electric science and arts was so rapid in the early days that it was relatively easy to find plenty of material for a review each year. Progress has continued and will continue, but naturally shows a decided tendency to saturation in many directions. In some instances, this saturation can be demonstrated to be due to the fact that limits of perfection have been so closely approached that little remains of possible accomplishment. In other instances the slowing up is due to lack of knowledge, or, especially at the present time, to lack of workers, such workers having been diverted to the work imperatively needed to secure us against the attack of our enemy on the foundations of our existence.

In the matter of efficiency, there has been no material improvement for several years in electrical units such as dynamos, motors, transformers, etc. The efficiencies stated in Past-President Lincoln's address, in 1915, still remain almost exactly of the same values and for the reasons which he so clearly pointed out.

The efficiency of conversion of mechanical into electrical energy, or the reverse, of electrical into mechanical energy, is still about 90 per cent, in the average case, under practical conditions of operation; the efficiency reaching as high as 97 per cent or 98 per cent in the most favorable cases, with the large units, and falling below 90 per cent in unfavorable cases, or in the small units. The efficiency of conversion of electricity from high to low potential, as in transformers, also remains substantially the same, reaching as high as 98 plus per cent in the largest units.

It is obvious, as Lincoln pointed out, that no change can be expected where such practical perfection has been reached. The situation with respect to the conversion of mechanical power of falling water into electrical energy by our water-wheels and electric generators has, for the same reason, remained stationary for several years, and no great improvement is possible in practice.

In the field of thermo-dynamic engines, represented largely by the steam turbogenerator unit, some improvement has been obtained. Lincoln stated that 75 per cent of Rankine efficiency had been obtained in some large modern steam turbo units in 1915. This has now been increased to 80 per cent in the largest units of 35,000 to 40,000 kilowatts, and 75 per cent is quite common practice even in such moderate sized units as 10,000 kilowatts. This improvement, while not large, is doubly important because of the great increase in the cost of fuel. It has been realized mainly by bringing the practical design more nearly in accord with the theoretical by increasing the number of stages or processes of steam extraction, reduction of various losses, and by improvement in many details which, when properly looked after, make, in the aggregate, gains of practical importance.

The following information illustrates the improvement in efficiency of turboelectric units beginning with the first 5000 kilowatts installed in this country, in 1903, and continuing up to the close of 1907:

		Steam conditions.				
Year.	Size.	Steam pressure Pounds.	Superheat Fahrenheit.	Back pressure. Inches.	Pounds per kilowatt-hour.	Per cent of Rankine efficiency.
1903...	5,000 kw.	175	0	2	24.00	37.8
1908...	14,000 kw.	200	125°	1½	13.50	66.1
1911...	20,000 kw.	235	100°	1½	13.20	67.0
1913...	20,000 kw.	200	200°	1	10 74	75.9
1916...	20,000 kw.	250	250°	1	10 00	78.5
1917...	35,000 kw.	230	200°	1	10.14	78.7

It is gratifying to note that a per cent of Rankine efficiency of approximately 80 per cent has been reached. This progress reflects great credit upon the designers of turboelectric machines and is a record of achievement only found in electrical development.

Concurrently with this improvement in the turboelectric machines, great advances have been made in the design and operation of the steam producing devices—the boilers, auxiliaries and other features of the modern power station. As a result the thermal efficiency has been rapidly improved. The thermal efficiency to which I refer may be stated as the ratio of the total energy produced at the terminals of the generator to the total energy in the fuel burned—expressed as a percentage. It takes account of all losses from the coal under the boiler to the electricity at the dynamo terminals. It is the ratio of the heat units in one kilowatt-hour divided by the heat units in the fuel consumed to produce 1 kilowatt-hour at the generator terminals.

This thermal efficiency is, after all, to the electrical engineer the most important measure of progress. It measures the advance in station fuel economy and, as stated, many factors in addition to the improvement in turbogenerators have contributed to the result. It may obviously be used to express the results of a single unit, consisting of turbogenerator with its bank of boilers and other accessories, or it may be used to designate the combined result of all the units in a given power station.

The progress in the case of a combination unit, i. e., turbogenerator, with its boilers, auxiliaries, etc., has been as follows:

Year.	Size of unit. Kw.	Thermal efficiency. Per cent.
1903	5,000	10.15
1908	14,000	15
1913	20,000	18
1917-18	35,000	21.6

For comparison, I may state that large gas engines in steel mill practice, under best test conditions, show 25 per cent thermal efficiency, but in actual operation an efficiency higher than 18 to 20 per cent is rare.

High-compression oil engines of the Diesel type, driving electric generators, realize 25 to 26 per cent thermal efficiency when new, but are difficult to maintain at such efficiency.

The figures given must not be confused with the much higher thermal efficiencies often quoted for gas and oil engines, which refer to indicated horsepower and not to electrical output.

The steam turboelectric unit has not reached its limit of thermal efficiency. Calculations show that, with pressure of the order of 500 pounds gauge, a thermal efficiency of 26 per cent should be easily realized.

As a matter of interest to electrical engineers, I may say, parenthetically, that the steam turbine in this country owes its existence and development almost entirely to the electrical engineer, and this is not surprising, as the electrical engineer was familiar with the advantages of rotary machines, and perhaps it is not too much to say, prejudiced in their favor.

While, as stated, the efficiency of electrical units reached about its limit some years ago, those familiar with electrical engineering development are aware that progress has been made and is still possible in the generation, transmission and utilization of electrical energy. The struggle for improvement in efficiency has been transferred from the unit to the aggregate, called the system. We cannot have a system of maximum efficiency without units of maximum efficiency, but individual units of highest efficiency do not, of themselves, insure that the system upon which they are used will be of the highest efficiency, so progress has been made in the direction of improving the system economy or system efficiency.

To obtain the highest efficiency in practical operation, the element of time enters as a powerful factor. Our conception of efficiency should not be limited to a consideration of the relation between the instantaneous value of available heat units in coal and the electrical units produced at the point or points of consumption, but should consider the relation between the total number of heat units in fuel consumed in a given time, say 24 hours, to the total number of electrical units produced and used in the same time. The attempt to improve the efficiency of the system has shown the necessity for utilizing the generating units and transmission and distributing systems for the maximum possible time.

This has led to the study of such questions as load-factors, of generators, of stations, and of the system as a whole, to the study of the diversity-factor, to the reduction of idle currents in alternating-current systems, by the use of synchronous condensers, to the reduction of no-load losses of all kinds, to means for the reduction of the constant losses in all machinery, in transformers, etc.

The resulting improvement has been effected not only by changes in designs of the units themselves, but also by their method of use, based upon the recognition of the fact that the elimination or reduction of the losses at light load will greatly improve the total efficiency, especially when the time of use of the apparatus under load is a small part of the total time.

Automatic substations have come into existence for transformers and rotary converters; different power houses of the same system have been tied together electrically; transmission lines of different systems have been interconnected so that the units may be usefully employed for the maximum period or lie idle or unloaded for the minimum time.

This general development has led to marked improvement in total energy efficiency, represented by the amount of fuel burned per electrical unit sold or utilized, and has also reduced cost of operation and charges for investment. There is still room for continued improvement in this direction and the progress will be rapid due to the pressure for maximum efficiency in the use of coal and of existing investment at the present time.

Many interesting examples of the methods and devices adopted to improve station and system economy and efficiency may be found throughout the country. In California, large electrical systems have been arranged to be tied together, electrically, for exchange of power. In Washington and Idaho, power systems under different management have made similar arrangements. In the South, all important hydroelectric systems have been tied together for exchange of power. The advantage, as I have stated, of such arrangements is better utilization of variable stream flow, improvement in load-factor, increased reliability of service, and the net result is to improve the efficiency of the system, not only financially, but in a purely technical sense. One most important advantage is the obvious reduction of the necessary investment in reserve machinery of every description. In Montana, eight hydroelectric plants successively use the same stream flow, the total effective head amounting to 600 feet, and not only is the natural flow of the stream thus successively utilized, but all the storage water is effectively used by

each plant in series. In this same system the yearly load-factor is stated to reach 75 per cent and the mean monthly load-factor to reach 80 per cent.

The interconnection of hydroelectric plants brings about another extremely important saving, based upon the variation of rainfall in amount and time on the different watersheds which are thereby brought to serve a common system. It frequently happens that there will be plenty of precipitation on one watershed, while another watershed may suffer from long continued drought. This condition varies not only in the same year but in different years. Interconnection serves to eliminate these variations by a process of averaging, and where the interconnected system covers a sufficiently wide area, a remarkable increase in total useful power is made available.

It has frequently happened that thousands of horsepower have been wasted over the dams of one system, the watersheds of whose plants happened to have a wet year, and at the same time, a nearby hydroelectric plant, supplied by another watershed, was without water power. The result has been that one system would be wasting power while the other was suffering from a power shortage which would frequently be made up by the operation of an auxiliary steam plant, burning a large amount of high grade coal. This condition has to a large extent been remedied by the interconnections to which I refer.

It has been estimated, and it seems a conservative estimate, that through the saving in reserve equipment, improvement in load-factor, and the diversity of different loads, the useful output of groups of large systems may through interconnection be increased about 25 per cent.

These advances have been more rapid during the last year, due to the imperative demands for economy, saving and increased efficiency imposed by the war. It is a great satisfaction that the foundation had all been well prepared during the times of peace.

Sixty-cycle systems have shown during the past few years a more rapid growth than 25-cycle, and it is now estimated that 60-cycle systems represent about 70 per cent of the total power supplied in the country. This is undoubtedly due to the lower cost of transformers, generators, induction motors, and similar apparatus. The relative growth of 60-cycle as compared with 25-cycle is reflected in the case of steam turbine installations. In 1910 about 60 per cent of the steam turbine electric energy of the country was supplied from 60-cycle units; in 1917 this had risen to approximately 75 per cent.

Marked advances have been made during the past year in the application of electricity to the electric furnace. It is estimated that the number of electric furnaces in the United States has increased about 40 per cent in the past year and that there are now in operation over five times the number that existed five years ago. The world's output of steel from electric furnaces has now grown to approximately 4,000,000 tons per annum.

Experience has demonstrated that the electric furnace can utilize the cheapest and most inferior raw material to produce steel of the most uniform and highest quality, with the greatest regularity. The cost of steel so produced, while reasonable, considering its quality, was higher, until recently, than that produced by the open-hearth method. It is now possible to produce electric steel at substantially the cost of that produced by the open-hearth method. This result has been brought about partly by the increased cost of the open-hearth method, due to a variety of well-known causes, but largely by a reduction in the cost of the electric furnace operation. The marked change which has taken place in the reduction of the cost of operating electric furnaces is based upon greatly increasing the rate at which energy is delivered to the metal, both during the melting and the refining period. This has reduced the time required for an individual heat and also the kilowatt-hours required per ton of metal melted, with a net result of increasing the daily output of the furnace.

Electric resistance furnaces of large sizes, for special heat treatment requiring unusual exactness, are being extensively used, producing results greatly superior to oil or gas-fired furnaces.

Electric welding, both by the arc and incandescent method, is being rapidly extended and is destined to greater development in shipbuilding and similar operations.

Electrical engineers have been devoting much time to the solution of many war problems. It is not desirable or possible to review such work at present, but when the veil is lifted, we will all be gratified with the result. We must content ourselves with the mere statement that this work has covered means for the detection of the pirate submarine; wireless signalling and telephoning for Army and Navy, and aircraft devices; searchlights of novel design and great power; improved methods in manufacture of ammunition, ordnance; electrochemical work of every description; electric welding; X-ray sets of greater simplicity and accuracy, and many other lines too numerous to even mention.

In my address at the opening of the midwinter convention of the Institute, in February, 1918, I called attention to the advantages which it seemed to me would follow a more general electrification of the steam railroads of the country. I merely repeat at the present time that electric locomotives have been so improved and simplified that they are competent to haul the heaviest train that can be held together with the present train construction; to operate at the highest speed permissible by the alignment of the road and independent of its grades; and that the electric locomotives can meet in the most efficient and adequate manner the transportation problems confronting the country, and offer better results than are now obtained or seem possible with steam locomotives.

There can be no question that railroad electrification is not only economical but imperatively needed to improve the present standards of steam operation. Our mountain districts are congested almost entirely by the limitations of the steam railroad systems, and the addition of more tracks, under such conditions, is not the best solution of the problem. The electrified divisions of the steam roads have been free from troubles during the past severe winter and I repeat that the coal famine which the country suffered last winter could have been largely avoided if the steam railroads had been electrified. Moreover, it should not be forgotten that steam locomotives burn about 25 per cent of the entire coal mined in the United States and that 12 per cent of the entire ton-mileage movement of freight and passengers carried over our railroad tracks is represented in cars and tenders required to haul coal to supply steam for the locomotives.

It is a truism, which has been frequently stated, that war requires the mobilization of the nation's industries and their devotion to essential work. This is especially true in this country, as it has been necessary in addition to create substantially new industries on an enormous scale, such as the production of ships, ord-

nance, ammunition, airplanes, chemicals, etc. To operate these industries, it has been necessary to mobilize to the fullest extent our available material and labor, but material and labor can only be converted into war work by the application of power. This power, in view of its great economy and flexibility, must be electrical.

While this country was fortunate in having available a magnificent system of power stations, so great was the magnitude of the demand for increased power, created by the war industries, that it is estimated that there will be a shortage of at least 500,000 kilowatts of electric power in the Eastern district.

It is vitally important that the great electrical power producing companies of this country should be helped in every way to meet the heavy demand which is placed upon them, as it has been demonstrated that the quickest, most efficient and altogether best way to meet the demand for power is through the expansion of such existing organizations and installations.

Fortunately, there is general appreciation of the fact and comprehensive schemes are under consideration which will provide for the erection of large steam electric power stations in the mining regions. Favorable locations exist which are within reach by transmission lines of electric power stations now serving large industrial areas. By interconnection, present investment and machinery will be better utilized and a large amount of additional electric power made available, without making any increased demand upon our congested railroad facilities.

It is evident, therefore, that we need to consider and put into effect every practical method for conserving our existing developments and, also, we should take a courageous view of the future and provide, at least as liberally, for the future growth as has been the custom of the managers of the great public service systems in the past. It has been their custom to build from two to three years in advance of existing requirements in anticipation of the future. I have yet to learn of a single important instance where such foresight has not been amply justified.

The session on Wednesday afternoon was devoted to papers relating to transmission and distribution problems, there being three papers, as follows:

"Split-Conductor Cables—Balanced Protection," by William H. Cole, of the Edison Electric Illuminating Company of Boston; "Aerial Cable Construction for Electric Power Transmission," by E. B. Meyer, of the Public Service Electric Company, Newark, N. J., and "The Application of Theory and Practice to the Design of Transmission Line Insulators," by G. I. Gilchrest, Pittsburgh, Pa.

The subject of the Thursday morning session was protective devices, at which four papers on this subject were presented. The Thursday afternoon session was devoted to two subjects which have been made prominent on account of the war; namely, the subject of nitrogen from the atmosphere and the conservation of fuel by means of the utilization of water power. At the sessions on Friday the following papers were presented:

"Precharged Condensers in Series and in Parallel," by V. Karapetoff, of Cornell University, Ithaca, N. Y.; "Method of Symmetrical Co-ordinates Applied to the Solution of Polyphase Networks," by C. L. Fortescue, of Pittsburgh, Pa., and "Sustained Short-Circuit Phenomena, and Flux Distribution of Salient Pole Alternators," by N. S. Diamant, Houston, Tex.

Abstracts of the papers appear elsewhere in this issue. A more complete report of the convention will be published in our next issue.

ELECTRICAL MANUFACTURING INDUSTRY IS RESPONDING TO NATION'S NEEDS.

Scope and Phases of Its Work, as Outlined by R. K. Sheppard of General War Service Committee.

One of the interesting addresses delivered at the recent meeting of the Electric Power Club at Hot Springs, Va., was that of Robert K. Sheppard of the General War Service Committee of the Electrical Manufacturing Industry.

Mr. Sheppard, in outlining the necessity for organized industry being prepared for every emergency, spoke in part as follows:

"Our nation has the right to call for, and her industries have the duty to give her, every unit of energy which will propel her enormous war machine most quickly and effectively against her foes. The Electrical Manufacturing Industry is one of nearly one hundred and fifty lines of business to begin that united industrial service. That is why your General War Service Committee was appointed.

"Its job is to gear together the hundreds of big and little wheels known as electrical manufacturers, to get all the wheels into the mechanism, to keep them there and in running order so long as there is any possibility of this particular mechanism being a help to our country in winning the war.

"The splendid work which you had done in connecting your branch of our industry with the Federal Government at Washington rendered material assistance to our efforts to further organize the industry. The remarkable service of the wire and cable manufacturers, under the able leadership of Mr. LeRoy Clark, gave the Federal authorities such a marked example of efficient collective service that equal service in case of shortage of supply would be heartily welcomed at Washington. Under the plan of your committee to organize the rest of the industry into similar groups, such service could be had from any section of the electrical industry.

"Already twenty-six such groups have been formed and several more are in process of organizing. Each group has chosen its own committee, through which to give its collective service in its special line of manufacture. Groups of manufacturers who hitherto have not found homes in any electrical association, voluntarily applying for places in the organization, have proven to the General Committee their eligibility for war service as electrical manufacturers.

"The demands for practical assistance which daily reach your committee from all directions amply justify its existence. It has become a clearing-house for all sorts of information and inquiries. A trivial incident, but yet an illustration of the unexpected calls for help, occurred recently when the Union Iron Works, of the Bethlehem Ship Building Corporation at San Francisco, needed a megger testing set which the Government had not been able to find in the market and for the delivery of which the manufacturers required at least sixty days. Your committee delivered the megger testing set at the shipyard in San Francisco in forty-eight hours after the call for help arrived in our secretary's office. Aid like this to the Government has been cordially acknowledged in every case. Early last December, by working together, you manufacturers of apparatus uncovered throughout the country a supply of certain sizes of motors which showed satisfactorily to the Priorities Committee that a supposed shortage did not exist."

NEW YORK JOVIANS HAVE OUTING AT BRIGHTON BEACH.

Rejuvenation Ceremonies and Entertainment Afforded Day of Enjoyment.

More than 200 members of the New York Jovian League, with their wives and guests, attended the annual outing and rejuvenation held at the Hotel Shelburne, Brighton Beach, Coney Island, Saturday afternoon and evening, June 15.

Tribune George V. W. Pelz, presided over the rejuvenation ceremonies, which took place in the afternoon. He delivered the short form initiatory service and administered the oath to four new members: Messrs. George H. Williams, Bryant Electric Company; Samuel Levine, General Electric Company; Thomas J. Finn, Electrical Products Company, and Edwin Hirchberger, Electrical Journal.

During the shore dinner, served by the hotel management, the revue "The Shelburne Girl" was reproduced for the entertainment of the Jovians. A cast of forty principals was augmented by a large chorus. Dancing, of course, held an attraction for many, perhaps on account of the splendid condition of the ball room floor. Both before and after the revue many Jovians and their friends responded to the call of the orchestra.

WAR PROBLEMS DISCUSSED BY SOUTHEASTERN SECTION, N. E. L. A.

Sixth Annual Meeting at Atlanta Devoted to Consideration of Rates, Service and General War Policies.

The sixth annual convention of the Southeastern Section, National Electric Light Association, was held on June 19 and 20 at the Piedmont Hotel, Atlanta. Each day's session was opened by the singing of the Star Spangled Banner. Each talk had interwoven with it some reference to the present world-wide war.

The first day's session was opened with a talk by Rabbi David Marx of Atlanta, on the subject "What the Public Expects of Public Utilities." In the course of his remarks he stated that times are changing so rapidly that it is hard for an ordinary man to keep pace with the general changes and it must without question be exceptionally hard for the professional man to keep abreast with the times and still keep up with the changes in his profession. Quite a compliment was paid to the men of the central stations who not only carry on their work, but had responded so liberally with their own time and their companies' resources whenever the Government called upon them. He further stated that the present is an age of suspicion, due mostly to war conditions. He also stated that the public expects many things, from dividends to participations, from participations to confiscations.

A general outline was given of the history of business from the time of the barter stage until the formation of corporations to carry on business too large for the capital of any single individual. He further stated that capital may be either individual or socialistic. Individual capital may be lost without hurt to the socialistic body. Where a public corporation has a monopoly the public is entitled to a dividend. These dividends should be paid in service. The company is entitled to dividends, they to be paid in money. He further stated that the public does not object to paying a fair profit on service which they buy. The question which is raised between the public and the public utilities is therefore not what is profit but what is fair profit. There should be profit, not profiteering, capital not capitalization.

Rabbi Marx ended his remarks by stating that he personally did not believe that at the present time utilities should be publicly owned, because leaving out all questions of fairness and justice, the American people are not educated to the point of taking over these corporations, which own millions of dollars worth of property.

W. H. Glenn of the Georgia Railways & Power Company, Atlanta, Ga., spoke on the subject, "Some of Our War-Time Difficulties." Mr. Glenn stated in the course of his remarks that the central stations, although manufacturers, still could not be properly classed with the ordinary commercial manufacturers. The ordinary manufacturer, when the burden is thrown upon him to increase his output, may either lengthen the hours of his labor or may run two or more shifts, thereby increasing his output without a material increase in overhead. Also should a burden of government work be thrown on an ordinary manufacturer, he can be relieved of furnishing his other customers. These customers may object, but still when the situation is explained, they, as a rule, will not make a serious kick. With the central station, it is practically impossible for them to state just what time and when the load shall come on and when ordinary business has imposed on top of it government work, that is, furnishing current for power and light to war industries such as new munition plants, cantonments, etc., the central station can not reduce its facilities voluntarily for serving other customers. Mr. Glenn stated that from 10 hydroelectric companies in the South, there was sold approximately one and one-half billions kilowatt-hours, this being generated entirely from water power, saving 1000 trains of 75 cars each, of coal. He further stated that he personally did not believe that public utilities, at the present time, were asking to raise their rates in order to make a profit, but they were desirous of being allowed simply to break even.

John W. Lieb, vice-president of New York Edison Company and past president of the National Electric Light Association, made a talk on "The N. E. L. A.—Its Work in Peace and War." Mr. Lieb, in the course of his remarks, explained the workings of the different committees of the association and also the problems which they had been called upon to solve, during the last year. He also explained the formation of the joint committee, between the National Electric Light Association and American Gas Institute, Illuminating Engineering Society and other technical societies which are endeavoring to help the Government in many difficult technical problems. Mr. Lieb stated that it was through this National Committee that there had been brought to the attention of the member companies, such activities, as the Liberty Loans, Red Cross drives, etc.

L. K. Comstock spoke on the subject "A Proposed System of Wage Adjustment." Mr. Comstock showed by a series of tables that it was possible to base wages on a certain definite sum and this wage could be adjusted from time to time in order to take care of the rise and fall in the cost of living.

The session of June 20 was opened by E. H. Sniffin who spoke on the subject of "Co-operation Between Manufacturer and Utility." Mr. Sniffin stated that the output of central stations increased about one hundred per cent every five years. Also that the expenditures increased in about the same ratio. He said that during the same period that the average man had

almost doubled his consumption of electric current, but it had only cost him 20 per cent more than the original. He said also, that in 1902, that for every $100 of capitalization there was about $75 invested. In 1912 for every $100 capitalization there was a $100 invested. In 1917 for every $100 capitalization there was approximately $125 invested. He stated that he believed the solution of the manufacturers' cost problems was the straightening out of their annual sales curve. He also recommended that a system of progress payments be inaugurated similar to that used by the builders' trade.

The following officers were elected to serve during the insuing year:

President, C. D. Flamigen, Athens, Georgia.

First vice-president, George W. Wygantt, Tampa, Florida.

Second vice-president, S. B. Irelan, Montgomery, Alabama.

Executive Committee, W. R. Collier, Atlanta, Georgia; L. L. Newman, Birmingham, Alabama; D. H. Cheney, Orlando, Florida; H. H. Carr, Raleigh, North Carolina; C. M. Benedict, Charleston, South Carolina.

MASSACHUSETTS ELECTRICAL CONTRACTORS PROTEST AGAINST GOVERNMENT PRACTICE IN ELECTRICAL CONSTRUCTION.

Request That Electrical Labor Be Employed Through Regular Electrical Contractor Channels.

Alfred J. Hixon, state chairman of the Massachusetts Association of Electrical Contractors and Dealers, after authorization by the executive committee, has sent to the members of the association a letter, calling their attention to the practice adopted on Government construction, under which the regular electrical contractors in the various communities have little, if any, opportunity to participate. The facts given, in part, are as follows:

"The Government is discouraging all non-essential building construction which is, under normal conditions, the principal source of business of the electrical contractors; and is encouraging the practice of employing its own electrical labor and purchasing materials direct or through a general contractor, thereby in the majority of cases making this work unobtainable by electrical contractors.

"The reason for this action is said to be to avoid duplication of percentages, but with the form of contract used, no limit is put upon the ultimate cost of the work, and the question of efficient administration in many cases is entirely lost sight of with regard to electrical construction.

"The Government is establishing conditions with reference to payment of workmen, due to the indiscriminate use of overtime, which is reflecting detrimentally upon the usual employers of electrical labor.

"I believe that the members of our association appreciate in a patriotic spirit that present conditions require a sacrifice on the part of every one, but in the same spirit I believe our members should be allowed to render a service to the Government, which, by their ability and organization, they render in peace times to the general public. There can be no question of the efficiency of employing specialized organizations, such as that of the electrical contractors, for the execution of electrical construction, since they are organizations which have been built up under competitive conditions in times of peace."

NATIONAL ELECTRICAL CONTRACTORS AND DEALERS WILL MEET IN CLEVELAND.

Tentative Program Gives Outline of Important Features of the Annual Convention.

The National Association of Electrical Contractors and Dealers will hold its annual convention at Cleveland July 15 to 20, inclusive, at the Hollenden Hotel. This will be the first meeting of the national body since the time of its reorganization under the Goodwin Plan at New Orleans last October.

Officers and committees are exerting themselves to secure a large attendance. They are very properly appealing to members in all the state organizations to be at this meeting, to ask questions, participate in the discussion and carry back to their associates at home the inspiration of the convention.

It will be one of those open meetings of which W. L. Goodwin is the exponent. He does not favor the secret session, but believes all propaganda and policies should be discussed in the open. Mr. Goodwin will be there, not as the boss, but as the inspiring leader which he is. One of the features of the convention will be the Question Box. Any question germane to the purposes of the organization will be answered by Mr. Goodwin in the clear, forceful fashion for which he is noted.

Monday and Tuesday, July 15 and 16, will be taken up with three sessions of the National Executive Committee, and a meeting of the Atlantic, Central and Pacific Divisions.

WEDNESDAY, JULY 17.

10 A. M.—Opening of regular convention by A. L. Oppenheimer, president Electrical Contractors' Association of Cleveland. Address of welcome by Harry L. Davis, mayor of Cleveland; response by W. Creighton Peet, national chairman; address by William Ganson Rose, president Cleveland Advertising Club.

2 P. M.—Paper on "Scientific System of Wage Adjustment," by L. K. Comstock of L. K. Comstock & Company, New York.

Labor Cost Data "Round Table" Conference, J. N. Pierce, Chairman Labor Committee.

9 P. M.—Reception and dance, Ball Room Hollenden Hotel.

THURSDAY, JULY 18.

10 A. M.—"Organization," James R. Strong, past president National Electrical Contractors' Association.

"The Goodwin Plan," William L. Goodwin.

2 P. M.—Comments on "The Goodwin Plan." Three speakers (not selected). Paper, "The Application of Electricity as Applied to Industrial Plants." Speakers selected later.

FRIDAY, JULY 19.

10 A. M.—Report of Resolutions Committee on Proposed Changes of National Constitution and By-laws. Report of other committees and other business.

Paper, "How to Open a Retail Store," G. M. Sanborn, past president National Electrical Contractors' Association.

2 P. M.—Paper, "How an Electrical Contractor Can Become a Successful Retailer." (Speaker selected later.)

"The Goodwin Question Box," by "Goodwin himself."

6:30 P. M.—Dinner dance, ball room, Hollenden Hotel. James R. Strong, song leader. (No speaking.)

On Saturday morning there will be a meeting of the Association's Executive Committee.

Commercial

Government Use of Electric Trucks—Line Extensions Under War Conditions—Utility Commission to Establish Rates

LINE EXTENSIONS UNDER WAR CONDITIONS.

Many Different Policies in Use for Meeting Abnormal Costs—Free Extensions No Longer Possible.

A committee was appointed at the recent Atlantic City convention of the National Electric Light Association to investigate and report as to the various policies which public utility companies have in vogue for making extensions of lines for power and lighting service under war-time conditions; and an important part of this committee's duty is to determine upon and recommend rules of practice that will result in establishing a uniform policy relative to such extensions.

The subject was thoroughly discussed at that convention by many public utility company representatives, the discussion revealing the existence of quite a variation in the manner of dealing with the matter of extensions to plants handling Government work and to those conducting operations in the ordinary lines of manufacture. In fact, the differences brought out were so numerous as to make a concensus of expressions impossible. The practices prevailing, according to the outlines given by numerous speakers, apparently are not so much the result of fixed policies as they are the outgrowth of conditions that presented themselves to each individual company.

Formerly, liberal practices were adopted in making extensions, as a means of establishing feeder lines to increase business. In those earlier years capital was available for expenditures necessary to develop new business in promising fields, and companies were disposed to meet consumers more than half way in the extensions.

Subsequent absorption of capital in war work, which made it difficult for public utility concerns to finance new enterprises, quickly caused a change to the general policy of keeping capital expenditures down to the minimum for the period of the war. This applied especially to line extensions; and under existing conditions, consumers whose power demands make line extensions necessary are required in some form or other to finance them in whole or in part. On this point there is a general agreement that some such policy is essential to meet those conditions. But in its application a considerable diversity as to terms of contract between power companies and consumers, relative to extensions, is evident. The creation of uniform methods in this matter is believed practicable.

The plan in use by several companies in Illinois, and by a few in other states, is for the customer to advance the sum necessary to make the required extension, the company agreeing to refund the amount in the form of certain deductions from his monthly bills. In many of the greater extensions for plants engaged in Government work, both the Government and plant owners have fully advanced the large sums necessary for extensions under various arrangements, most of which provide for a refunding of the cost of construction after the close of the war. In other cases, as cited by speakers at the convention, extensions have been financed under an agreement for refunding only half of the cost in the shape of bill deductions. Another instance was cited of a customer who wanted power lines extended to his plant was asked to subscribe and pay for stock in the utility company of an amount sufficient to meet the cost of the required extension.

Another phase of the subject was with reference to extensions made for war purposes only in which two situations may exist: one in which the extension is likely to become of commercial utility after the war, and the other in which there is no likelihood of its becoming a part of the general system. It is readily apparent that the two propositions may justly require different terms of contract.

A survey of the general field, not only as disclosed by expressions at the N. E. L. A. convention, but by other sources of information, shows that there has been no hesitancy on the part of the Government, nor of manufacturing concerns, in advancing the funds necessary to connect new industries with central-station power lines. It is observed that there has been quick co-operation in this matter between power producers and power consumers, and the terms of contract have been largely a matter of negotiation between each company and its patrons.

The result has been to enable the utility companies to sell energy to the limit of their capacities without the expenditure of much additional capital for extensions. The work laid out for the committee appointed at the N. E. L. A. convention, should result in segregating and classifying facts as to the numerous conditions existing, so as to make it possible to standardize terms for extension charges and to adapt them to different situations.

SEATTLE COMPANY SELLS BONDS TO COMPLETE NEW CONSTRUCTION WORK.

Will Arrange to Use Coal Instead of Oil—Earnings for the Year from All Properties.

W. H. McGrath, vice-president of the Puget Sound Traction, Light & Power Company, Seattle, Wash., states in regard to the recent issue and sale of $12,250,000 seven-per-cent three-year notes in Boston, that the proceeds will be used for the purpose of refunding notes maturing February next, and to complete new construction at the White River power station, and for additions and necessary accessories in steam plant at Seattle. Additional power units and provisions for changing from oil to coal will cost about $1,900,000. These changes and improvements are now being made and will represent that much additional plant investment. The net earnings of $3,866,050 for the year

ending April 30, 1918, are those accruing from the company's various properties, including the street railway systems of Seattle, Tacoma, Everett and Bellingham; of three interurban lines, four hydroelectric and five steam power plants, with a combined capacity of more than 160,000 horsepower, with 551 miles of high-tension transmission lines; light plants and distributing systems in Seattle, Tacoma, Everett, Bellingham, Mount Vernon, Kent, Auburn, Sedro Woolley, Burlington, and other smaller places, comprising 136 towns and villages in all, as well as the Renton coal mines.

GOVERNMENT USE OF ELECTRIC TRUCKS.

Successfully Employed in Various Applications at Considerable Saving in Cost.

Electric vehicles are used extensively in five navy yards, three arsenals and several depots in hauling mail and parcel-post matter, and at the various departments of the Government in Washington. Also at Panama, and by the Bureau of Insular Affairs in Manila.

The electric truck is given preference at the navy yards for the reason of economy and freedom from fire risk, and the reason of handling by employees, many of whom are incompetent to operate, much less to care for, gasoline trucks. The latter are practically barred from many sections of the various yards where inflammable stores, ammunition, etc., are handled.

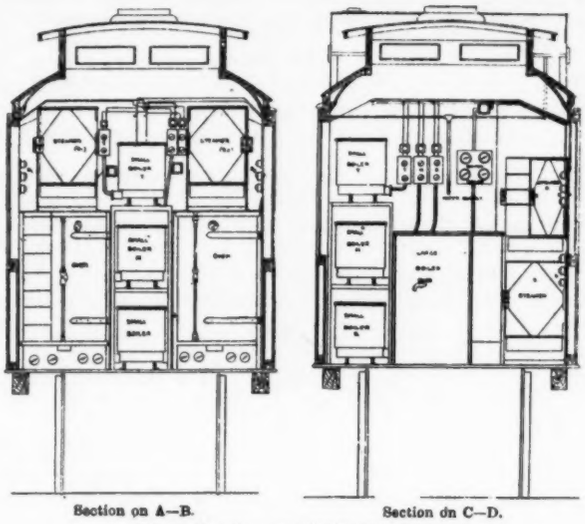
At the arsenals, the same general advantages are found for "electrics" where they are called upon to haul smokeless powder and similar munitions; oils, acids, naphtha, etc., as well as guns of many calibers, machinery, etc.

The dependability of the "electric" in mail work is well known, in fact, the "electric" is often given the hardest routes, namely, those involving close schedules under traffic conditions, which gasoline trucks find difficult to negotiate, at least under the time limits specified.

Electric industrial trucks and tractors, in addition to wide application in this country, are being extensively employed in France, where they are expediting the movement of men and munitions in our fight for freedom.

POWER RATES OF CLEVELAND MUNICIPAL PLANT TO BE ADVANCED.

The Board of Control of Cleveland's municipal electric plant has been asked by the Commissioner of Lighting to advance power rates 15 to 20 per cent, to become effective on July 1. This action, it is stated, is to meet the increasing costs of operating. It is understood that 255 power users will be affected by the proposed increase.



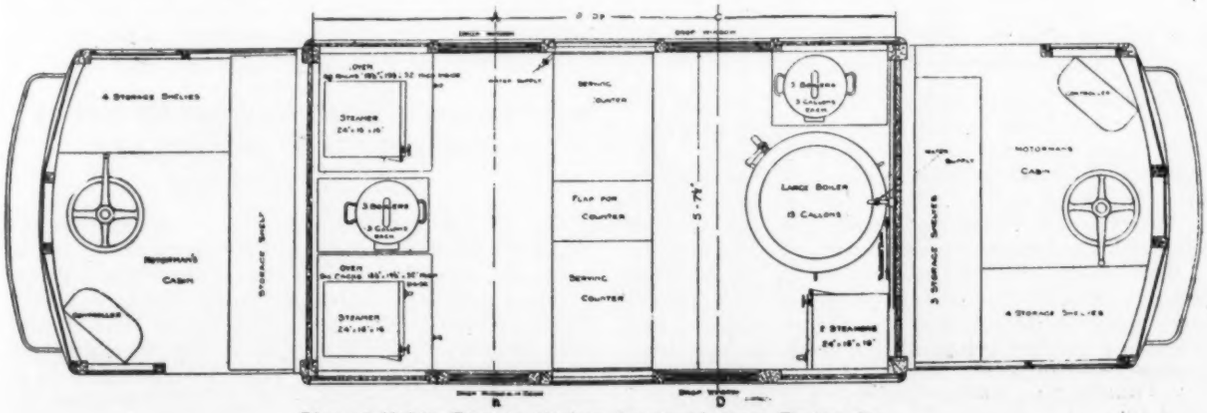
Cross-Section of Mobile Kitchen.

MOBILE ELECTRIC KITCHEN MEETS WITH FAVOR IN HALIFAX, ENGLAND.

Herewith are reproduced two drawings, showing the plan and sectional end elevations of a mobile kitchen, as presented by J. W. Galloway, tramways engineer, Halifax. In the sketches given the layout of the electrical cooking apparatus is shown. This is an adaptation of electrical cooking to a Halifax tramcar which is in regular daily service, where its utility is meeting with the favor of the public. The high-voltage cookers utilized on this car are reported as working very satisfactorily. This mobile kitchen is able to adapt itself to the convenience of the residents of a large district by delivering hot cooked food practically at the doors of those served. There appears to be developing in Halifax a plan for the combination of the central kitchen, fixed distributing depots and mobile kitchens.

GOVERNMENT NITRATE PLANT WILL USE CENTRAL-STATION POWER.

The United States Government's plant for producing nitrate, being built at Elizabethtown, 20 miles from Cincinnati, is to be supplied with power by the Union Gas & Electric Company, Cincinnati, a contract for which was recently made.



Plan of Mobile Electric Kitchen Developed From Trolley Car.

PUBLIC UTILITY COMMISSION HAS POWER TO ESTABLISH ELECTRIC RATES.

New Jersey Court Holds That Commission Can Regulate Regardless of Franchise Arrangements in Force.

An important decision has been rendered by the Court of Errors and Appeals, Trenton, N. J., in upholding the right the Board of Public Utility Commissioners to fix rates for utilities operating in the state regardless of any franchise arrangements in force between electric and traction companies and municipalities. This ruling annuls the recent decision of the State Supreme Court holding that the Commission is without such power and that utility interests in rate controversies must be guided by their agreements with municipalities.

The principal case before the court was that of an appeal by Bradley Beach and the Public Utility Commissioners on the decision of the Supreme Court in setting aside an order made by the Commission for the issuance of transfers between the connecting lines of the Atlantic Coast Electric Railway Company.

In its decision the Court of Errors and Appeals says:

"The traction acts of 1893 and 1896 do not expressly authorize municipalities to contract with street railway companies. The power is implied from the power to grant or refuse consent to a location of tracks, and to impose lawful restrictions; thus, the implication of power should not be extended beyond the necessities of the case. Full effect can be given to the language of these traction acts by holding that the force and effect of a contract under section 22 of the act of 1893 is the force and effect of a contract by which the municipality and the railway company, the only parties thereto, are bound, but that no restriction is thereby implied on the sovereign powers of the state to fix just and reasonable rates as subsequent conditions may make desirable. The power of a municipality to impose lawful restrictions upon granting consent to the location of tracks of a street railway must be lawful not only at the time, but from time to time, or at all times."

Under this decision the Board of Public Utility Commissioners is empowered to exercise full rate-making powers, either for decreased or increased charges, over public utilities in the state and without particular regard to any franchise agreements existing between electric companies and municipalities.

HAULING ICE ELECTRICALLY.

New Type of Electric, with Front Wheel Drive, Makes Its Appearance for Light Work.

Summer brings us heat,—and cold if we pay for it. Ice, after being stored and cut (natural ice), or made, must be delivered at considerable cost. The Commercial Economy Board, Council of National Defense, Washington, D. C., conducted an investigation in that city and found that nearly one half of each dollar paid by consumer went for transportation.

The electric vehicle has proven to be the most economic means of city transportation. Ice dealers have carefully investigated the electric vehicle and, as a result, they are being adopted in increasingly large numbers, particularly in wholesale delivery.

A Philadelphia manufacturer has developed a special type of electric truck for meeting conditions that cannot be economically handled with the ordinary 5-ton equipment, particularly where the time for loading and unloading is relatively great, where short hauls and congested traffic is encountered, and where the conventional truck, which is designed to do considerably more work than it can usually do on account of restricted conditions, will cost more for the work performed than horses.

The special electric truck is arranged to drive on front wheels only, the large rear wheels being steel tired; the speed is lower and the battery smaller, resulting in a materially reduced first cost, and a reduction in amortization and interest. Maintenance is also greatly reduced, resulting in a total cost lower than the cost of doing the same work with the horse equipment.

A PUBLIC ELECTRIC KITCHEN IN LONDON.

The Poplar (London) municipal authority has opened a communal kitchen, which supplies 2000 electrically cooked portions of food to the public daily. Seats and tables are provided for 250 people at a sitting and 500 take their meals in this way, the rest of the above number of portions being taken away for consumption at home in the people's own dishes. There is a three-oven (B. & K.) range, a carving table and hot cupboard, a three-compartment baking oven, two grills, five boiling plates, also a selling baking oven, electric mincing machines, potato peelers, etc. Energy is obtained from the popular municipal electricity works at one cent per unit. The Government inspectors, under the Minister of Food, recently stated, after a visit, that they could not speak too highly of the merits of electric cooking from the standpoints of cleanliness, convenience, uniformity, etc.; they also testified to the saving of meat effected with electric cooking. The public can buy food in small quantities for five or six cents and a three-course meal for 15 cents.

ELECTRIC RATE INCREASES GRANTED.

The Missouri Public Service Commission has granted an increase to the St. Joseph Railway, Light, Heat & Power Company on all lighting rates, amounting to 9 mills per kilowatt-hour, which will mean an increase in lighting revenue of $8000 a month. The appeal for this increase was made two months ago, the company having already received an increase in power rates.

The United Water, Gas & Electric Company, of Hutchinson, Kan., recently was granted an order by the Kansas Utilities Commission adding a surcharge of 3 mills per kilowatt-hour to all existing electric power rates, and to current supplied for electric ranges and battery-charging services. This will add 13 per cent to the company's gross earnings.

MINNEAPOLIS COMPANY SALES DEPARTMENT GIVES ELECTRICALLY COOKED DINNERS.

H. E. Young, sales manager of the Minneapolis General Electric Company and Northern States Power Company, recently gave an electrically cooked dinner to the 25 members of his sales force. The menu, which was quite substantial, was prepared by Miss Bernice Bell, domestic science expert of the company, and Miss V. I. Thorson, of the sales department, with an electric energy consumption of 2.7 kilowatt-hours at a cost of 6.8 cents at the rate prevailing in Minneapolis.

Contracting-Construction

Croft Discusses Conduit Benders of Different Types—Suggestions on Resistance Units—Chain Wrench—Work Support

BENDING RACKS AND ROLL BENDERS FOR LARGE CONDUIT AND PIPE.

Special Types of Roll and Vise Benders.

BY TERRELL CROFT.

[*This is the second of a series of articles describing benders chiefly for the larger pipe and conduit sizes. They form a conclusion to the two other series of articles by the same author which appeared in the* ELECTRICAL REVIEW *as follows: "Methods of Bending Conduit," seven articles in issues of January 12 to February 23, 1918; "Some Comments on Conduit Benders," four articles in issues of April 27 to May 18, 1918. These earlier articles dealt with small and medium-sized conduits.*]

A Twin-Spool Conduit-Bending Rack (Fig. 8) is often convenient for forming curves in tubes of the

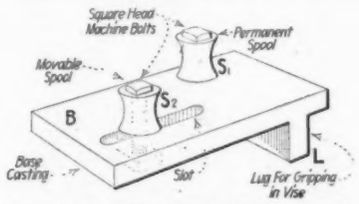


Fig. 8.—A Twin-Spool Bending Rig.

smaller diameters. The rack reproduced in Fig. 8 consists of a cast-iron base casting B, upon which are mounted two grooved metal spools S_1 and S_2. Spool S_1 is permanently bolted in place, while S_2 may be shifted in the slot, to provide for making bends of different radii. A lug L extends down from the bottom of the base so that it may be gripped in a vise on a work bench.

Commercial Twin-Spool Bending Racks of a number of different designs are manufactured. One of these of typical design is diagrammed in Fig. 9. All of them comprise about the same elements: First, a frame casting C; second, a permanently located, grooved spool or sheave S_1; third, an adjustable

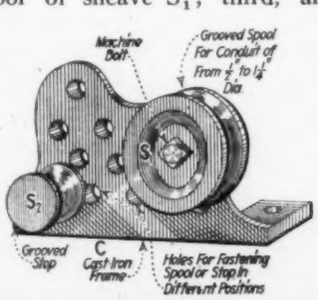


Fig. 9.—The Rex Conduit Bender Made by M. B. Austin & Company.

grooved sheave or spool S_2. Racks of this general design are provided with bolt holes whereby they may be attached to the work bench or to some member of the building wherein the conduit installation is being made.

A Twin-Spool Rack for Forming Short-Radius Bends in Small Conduits can be assembled as detailed in Fig. 10. Obviously, this comprises the three essential elements described above—a frame or base plate F, a stationary spool S_1, and a movable spool S_2. It may be desirable to have both S_1 and S_2 movable as shown. Where the bends are to be made to a very

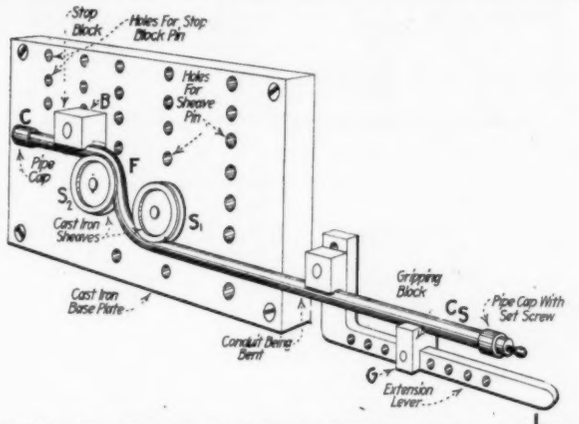


Fig. 10.—Arrangement for Making Short-turn and Complicated Bends in Small-Diameter Tubes.

short radius, it may be necessary to fill the tubes with sand as suggested in Fig. 11 before they are bent. This process was first described by Charles Eisler in American Machinist for March 23, 1916.

S_1, S_2 or the stop block B of Fig. 10 may be fastened in any one of a number of locations in the base plate, by bolting them through the hole at that location. The extension lever L is used in combination with the gripping block G where the extending end of the tube to be bent is short. It increases the length of the lever arm so that the operator will have no difficulty in forming a conduit.

A novel feature of this process is the method used in compacting the sand with which thin tubes are filled

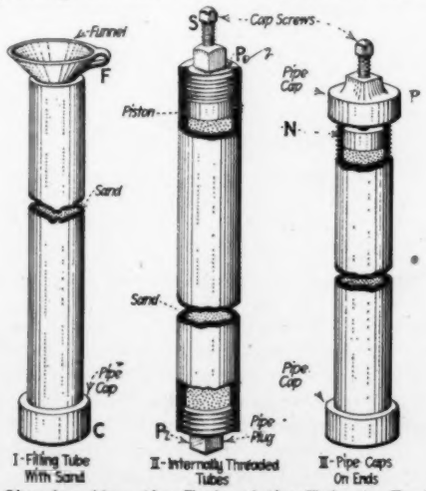


Fig. 11.—Showing How the Ends of the Tube to Be Bent Are Plugged and How It Is Filled With Sand.

while they are being bent. This is graphically demonstrated in Fig. 11. The first operation is to screw a pipe cap, *C*, on one end of the conduit to be bent as shown at *I*. Then the tube is filled with sand, by pouring it through a funnel *F*. On the upper end of this

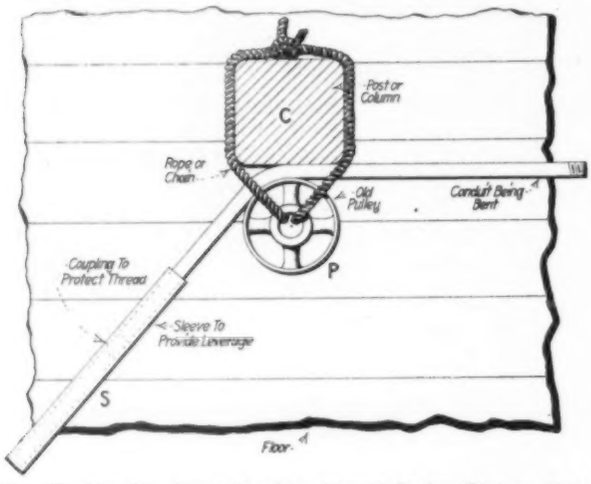


Fig. 12.—Bending Small Conduit Around Pulley Tied to Post.

tube is screwed a pipe cap P_1, which has screwing through it a cap screw *S*, as shown at *III*. This cap screw bears against a piston *N*. Hence, when the upper cap P_1 is placed on the pipe and the cap screw is turned, the sand within it is compressed. Where the tube is internally instead of externally threaded, the arrangement then used is delineated at *II*.

An important precaution should be observed. If the filled tube is to be heated prior to bending, the sand within it must be dry. If wet sand is placed in the tube a disastrous explosion may result. Whether or not it is necessary to heat the tubing before the bend is made will be determined by the diameter of the tube which is being bent and by the radius of the bend. It is not necessary to heat small tubes for large-radius bends. Where a bend is to have a short radius, it may be necessary to heat it. This question can be best answered by experiment. Sand fillings positively prevent buckling and kinking.

A Bending Rack Improvised by Tying a Pulley to a Post (Fig. 12) may be used in an emergency. The

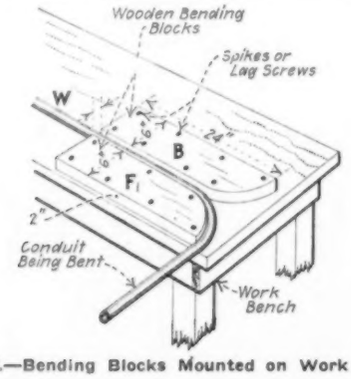


Fig. 13.—Bending Blocks Mounted on Work Bench.

pulley *P* is held to the column *C*, or to some similar member of the building, with a chain or rope threaded through its hub. The process of bending will be obvious from a consideration of the illustration. Where the end of the conduit which extends beyond the pulley is too short to provide a sufficient grip and leverage, an extension sleeve *S* may be slipped over it. If the end of the conduit which the sleeve slips over is threaded, a coupling should be provided on this threaded end to protect the thread, in which case the sleeve *S* must be of sufficient internal diameter to slip over the coupling.

Bending Blocks Secured to the Top of the Work Bench comprise a type of bending rack (Fig. 13) which is very popular in forming ½ and ¾-inch conduits for interior-wiring installations. Some of these racks have one form, F_1, with a grooved edge, while the other block, *B*, has all of its corners square. The arrangement shown in Fig. 13 with two rounded-corner forms is preferable, in that with it the operator may bend the conduit in either direction.

Usually, the blocks *B* and F_1 are of about the dimensions suggested in the illustration, but the effectiveness of the outfit is not impaired even if its dimensions are widely different from those suggested. Instead of the blocks being nailed to the top of the work bench, they are sometimes attached to a plank secured on horizontal members extending from studs in the building. For best results, the width *W* of the slot between the two blocks should be just large enough to admit the conduit. However, ¾ and ½-inch tubes may be satisfactorily handled on the same form.

Combination Pipe Vises and Benders are, in reality, examples of the bending rack as defined in a preceding paragraph. A typical bender of this type is that (Fig. 14) manufactured by M. B. Austin & Com-

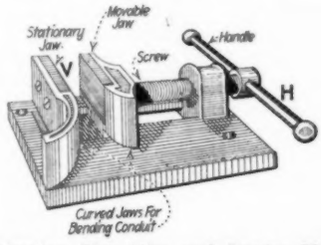


Fig. 14.—Combination Pipe Vise and Bender Manufactured by M. B. Austin & Company.

pany. The conduit to be worked is clamped in the vise *V* by tightening the handle, *H*, of the screw and it is then bent by the operator around the grooved form as desired.

(To be continued.)

SUGGESTIONS ON CARE OF RESISTANCE UNITS.

By A. Gemmell.

The resistance unit forms an important part of the industrial-plant electrician's burdens today. It is used in many different ways and under many different conditions. A resistance unit will wear out or burn out quickly if the proper care of it is not taken, or if it is not installed properly. A few suggestions on this subject may therefore not go amiss.

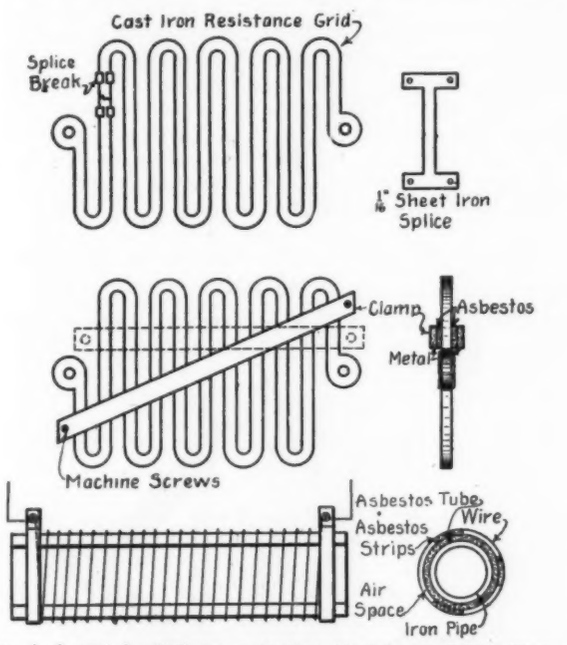
Fig. 1 shows a cast-iron resistance grid. Units of this style are liable to break or crack, as shown. It sometimes happens that the electrician who is called on to make repairs when trouble of this kind occurs is handicapped because he has no extra grids on hand. If a piece of sheet metal is cut to form a splice, as shown, and put over the break, and two pieces of good strong wire are put through the holes shown and twisted tightly, it will be found that this repair will keep things in running order until replaced by a new grid.

Many of us know that where resistance units are in use on traveling cranes, near retorts or near ma-

chinery that vibrates very much, the chances are much greater for them to break, as the vibration adds to the strains of contraction and expansion caused when the current goes off and on.

Fig. 2 shows a method that will help greatly to stop this trouble in many cases. The clamp is made of two metal strips and two asbestos strips of the same width; the asbestos is put next to the resistance and the metal on the outside. The machine screws are then tightened up snugly. Small screws and nuts can be used if the space between the resistance ribs will permit. If the units are in use in the vertical position shown in the drawing it is advisable to put the clamp on in the position shown by the dotted lines, as it cannot slip down in case it gets loose, but if in use lying flat, the cross position shown solid will do. The idea of this clamp is to help take up the weight and stop the vibration. Keep the clamp snug at all times, if possible.

Fig. 3 shows a simple improved resistance unit.



Figs. 1, 2 and 3.—Splicing a Broken Resistance Grid. Clamp to Prevent Grid Vibration. Ventilated Resistance Wire Unit.

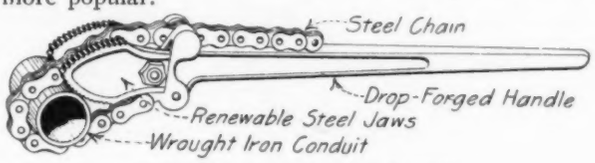
Units of this style are used quite extensively in both vertical and horizontal positions. The feature of this unit consists of the three strips of asbestos put on the asbestos covering that surrounds the pipe. In the old way the wire was wound around directly on the first asbestos covering and the wire did not penetrate it far enough to hold the turns from coming in contact after the resistance had been heated, as heating causes the wire to expand, and it seldom goes back to its former length again. If, before winding or rewinding units of this style, strips of asbestos are cut and put on top of the asbestos tube with shellac and then after drying the wire is wound on in the usual way, you will find that the wire will cut into the asbestos strips and will hold the turns in place much longer than if just wound on the round surface of the asbestos tube. There will also be an air space around the wire which will help greatly to keep it cool.

These methods have proved their worth and are simple and cheap, as no costly changes have to be made to put them into use.

WRENCHES FOR CONDUIT.

By C. W. Connette.

There appears to be a difference of opinion among practical wiremen as to whether the old-style Stillson wrench or the so-called "chain wrench" is preferable for conduit work. Both types have their advocates, but it is believed that the chain wrench is becoming more popular.



Chain Wrench as Used for Conduit.

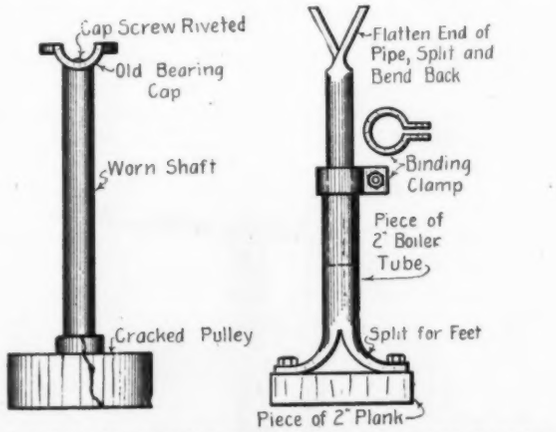
The chain wrench has the advantage that it can be used in corners and in restricted locations where it is difficult to use a Stillson wrench. The reason for this is that it is often difficult to get the jaw of a Stillson wrench between the conduit and a wall or other surface. The chain on a chain wrench requires much less space than does the jaw on a Stillson wrench and can usually be squeezed between the conduit and the surface upon which the conduit is supported.

The chain wrench has the further advantage that, after its chain has once been wrapped around the conduit and notched in the catch of the wrench, it will remain on the conduit until released, thus permitting the wireman to manipulate it with one hand. Furthermore, the chain wrench can be adjusted almost instantly for conduit of any diameter, whereas it takes relatively quite a considerable time to adjust jaw wrenches for different sized conduit or pipe.

WORK SUPPORTS MADE FROM DISCARDED MATERIAL.

By Chas. H. Willey.

The illustration herewith shows two types of work supports that came to my notice on recent visits to power plants in the East. Fig. 1 is rather odd, and not every plant has that kind of old discarded machinery lying about from which to make one. The one shown in Fig. 2 is by far the best, for it is easily constructed from some pipe or old boiler tube, and it has the additional feature of being adjustable to a wide range of heights. The sketches are self-descriptive.



Figs. 1 and 2.—Handy Work Supports Made from Old Material About the Plant or Shop.

New Appliances

Fuseless Rosette—Heavy Bus Support—Unique Safety-First Switch Panel—Automatic Rack for Electric Soldering Irons

BRYANT FUSELESS ROSETTES.

The Bryant Electric Company, Bridgeport, Conn., has recently placed on the market a line of fuseless rosettes for 3¼ and 4-inch outlet boxes, all of which are National Electrical Code standard. These rosettes are made in two types, with and without terminals, the latter for use when the line wires lead directly to the lamp socket. The rosettes for 3¼-inch outlet

Front and Back Views of New Fuseless Rosettes.

boxes are 3⅝ inches in diameter, with elongated holes for supporting screws spaced 2¾ inches in diameter.

For 4-inch outlet boxes, they are 4⅝ inches in diameter with holes for supporting screws spaced 3½ inches on centers. The design of these rosettes is symmetrical and quite attractive.

EXTRA HEAVY-DUTY BUSBAR SUPPORTS.

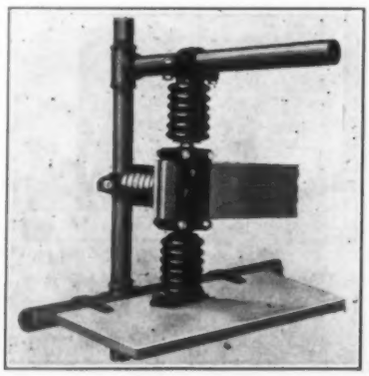
In modern high-capacity central stations the main generator bus is one of the most vulnerable places, and this necessitates extreme care in both design and installation of the busbar supports. Failure of a bus support may produce a disastrous short-circuit and in any case will entail complete shutdown of certain sections. As a main bus may be considered a principal artery of the electrical system, especial care must be taken to safeguard it.

In small-capacity stations it is only necessary to guard against electrical failure of the bus support. This is a comparatively easy matter, simply entailing the use of a larger porcelain which will give a higher safety factor than ordinarily required for substation work.

In stations of large capacity, however, short-circuits on the outgoing feeders or station equipment will develop tremendous momentary short-circuit currents which will "motorize" the buses, setting up forces between bars which may easily reach values or several hundred pounds per running foot of bus. The problem thus becomes one of mechanical strength and due to the comparatively low mechanical strength of porcelain is not easily solved.

A mere increase in bulk of porcelain will often lower rather than increase the mechanical strength and may also lower the electrical qualities. The well-known laws of mechanics can therefore only be applied after a thorough study of the nature, characteristics and manufacture of porcelain.

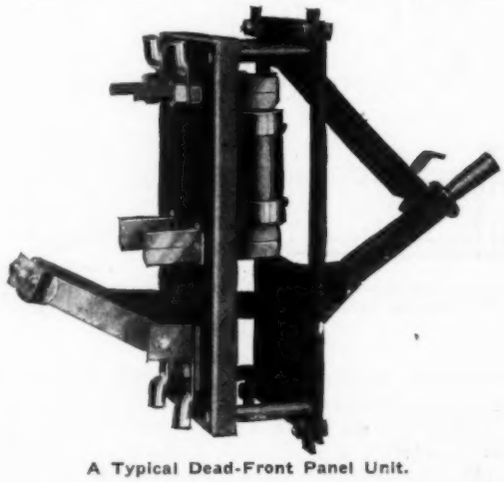
The type of extra heavy-duty busbar support illustrated, and manufactured by the Delta-Star Electric Company, Chicago, Ill., has been found to possess an ultimate strength of 60,000 pounds against short-circuiting forces between busbars.



Extra Heavy-Duty Busbar Support.

LOW-TENSION DEAD-FRONT SWITCH PANEL.

The illustrations herewith show a line of dead-front panel switches made by the General Electric

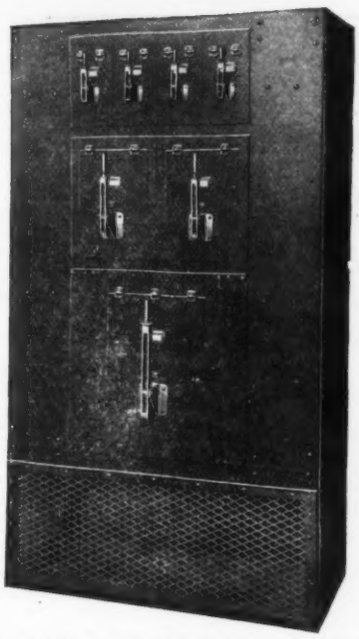


A Typical Dead-Front Panel Unit.

Company, Schenectady, N. Y. These switches represent a highly important "safety first" development. Primarily the panels are intended as distributing panels for light and power, and for generator and feeder panels for small lighting and power plants. Due to their high factor of safety they are especially valuable in factories where the switchboards are operated by inexperienced or careless employees.

A switch unit consists chiefly of standard knife switch and fuse clip parts, mounted on a slate base and supported by iron studs at the back of a sheet-steel panel. The steel panels are 3/16-inch thick and their other dimensions are graded so that they present a uniform appearance even when several sizes are mounted together.

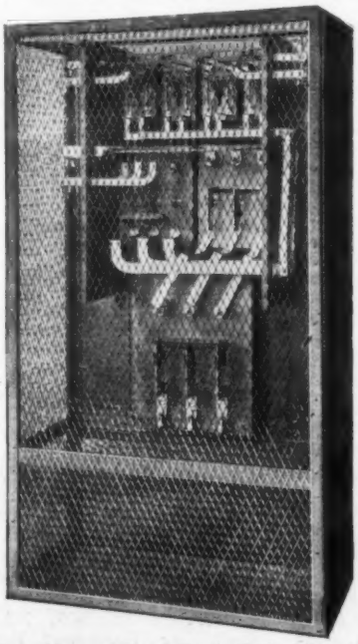
The operating handle has the same general appear-



Front View of Dead-Front Switch Panel.

ance as an oil circuit-breaker handle and is so arranged that it is in the vertical position when the switch is "on" and at an angle of 60 degrees with the panel when the switch is in the "off" position. The operating link passes through both the steel panel and the slate base and transmits the motion from the handle to a lever attached to the cross bar of the switch.

The steel panel of the switch unit is provided with a sheet-metal door which is hinged at the top, allowing it to open upward as far as the top on the operating handle behind which it is mounted. This door gives access to the fuses from the front panel, but cannot be opened while the switch is "on." When this door is open, the switch cannot be closed. Fuses can be inspected or replaced at any time, but the operator cannot come in contact with the live current-carrying parts as the fuses are on the load side of the switch, and



Rear View of Dead-Front Switch Panel.

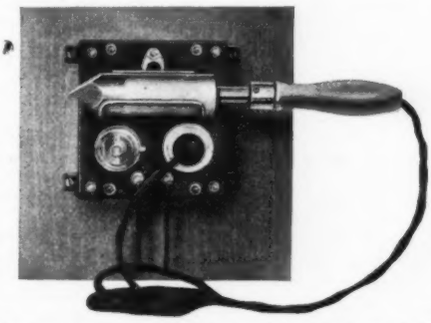
the fuse clips must be dead before the fuse-compartment door can be opened. The switch can be locked in the "off" position by an ordinary padlock. The capacity of the switches is limited by the sizes of 250 and 600-volt inclosed fuses as approved by the National Board of Fire Underwriters. The current ratings range from 60 to 600 amperes.

The panel frame is built of riveted angle iron, and the current-carrying parts back of the panel are inclosed in expanded metal. The wires and cables may be brought out at the top or bottom of the panel.

NEW AUTOMATIC RACK FOR SUPPORTING AND PROTECTING ELECTRIC SOLDERING IRONS.

Electric soldering irons which are left to lie on a bench or other convenient place when temporarily not in use, gather dirt and become a hazard. Often the tip will be overheated, necessitating refiling; the heating unit may burn out; or the hot iron set fire to the bench or other material. If the current is turned "off" the iron cools down to such a degree that considerable delay is caused when the iron is again wanted.

To overcome these objectionable features the Cutler-Hammer Manufacturing Company, of Milwaukee and New York, has recently developed an automatic soldering-iron rack and control panel which decreases



Cutler-Hammer Automatic Soldering-Iron Rack.

the amount of current taken by the iron when it is placed on the rack. This keeps the iron from overheating, prevents burnouts, and saves current and further encourages orderliness by providing a convenient connection point and support for the iron. The rack consists of a small slate panel arranged for wall mounting and carrying a support for the iron which acts on the principle of the telephone receiver hook. When the iron rests on the support or hook it bears the support down and resistance which is mounted on the back of the panel is inserted in circuit with the iron. The current is reduced and the temperature held at a safe value, but ready for service and full current just as soon as the iron is lifted from the hook. Taking the weight from the hook disconnects the resistance from the soldering iron circuit and allows full current to flow. Below the hook, on the same panel, there is a push-button snap switch and a "standard" receptacle to which the plug of the soldering-iron cord is connected. This little panel, therefore, is a complete switchboard which may be mounted on the wall or machine within reach of the workman. When not in use and at night, the switch is snapped "off" which completely opens the circuit to the iron.

These automatic racks are designed for use with C-H soldering irons but may be used with other similar types as well.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

NEW HAVEN, CONN.—Eastern Machine Screw Corporation, Truman street, has awarded a contract for the construction of a one-story boiler plant at its works. C. W. Murdock, 185 Church street, New Haven, is the contractor.

THOMPSON, CONN. — Grosvenor Dale Company has commenced work on the proposed alterations and improvements in its water power plant in the North Grosvenor Dale section of Thompson. The J. W. Bishop Company, 109 Foster street, Worcester, Mass., is the contractor.

BOSTON, MASS. — The United States Government, Navy Department, has awarded a contract to Rideout, Chandler & Joyce, 178 High street, Boston, for improvements and alterations in the power plant at the local navy yards, to cost $31,000.

SHERBORN, MASS.—Sherborn Reformatory for Women is having plans prepared for the construction of a large power plant at the institution to cost about $70,000. Mrs. Jessie D. Hodder is superintendent.

BINGHAMTON, N. Y.—Binghamton Light, Heat & Power Company has commenced the removal of the 2000-kilowatt turbine from the old plant to the new addition recently completed, and it is expected that operations will be inaugurated at an early date.

BROOKLYN, N. Y.—Paul M. Marko & Company, 1191 Bedford avenue, manfacturers of storage batteries, etc., have filed notice of an increase in their capitalization from $50,000 to $75,000, to provide for expansion.

BUFFALO, N. Y. — Pullman Company, Marine Bank building, has taken out a building permit for the construction of a power plant at its works at 1770 Broadway. The structure is estimated to cost about $27,000.

GALWAY, N. Y.—The board of managers of the Saratoga County Homestead Sanitarium is considering plans for the erection of an addition to the power plant at the institution to cost about $12,000.

GARDENVILLE, N. Y. — Pennsylvania Railroad Company has had plans prepared for the construction of an engine plant at its local works, to cost, in connection with other structures, about $75,000.

NEWARK, N. Y.—The board of managers of the New York State Custodial Asylum has had plans prepared for alterations and improvements in the heating plant at the institution, to cost about $35,000. Lewis F. Pilcher, Capitol, Albany, is state architect.

NEW YORK, N. Y.—Liberty-Washington-Cedar Street Corporation, recently organized, has taken over the eleven-story Electrical Exchange building covering the block front of the east side of Washington street, from Cedar to Liberty street. The building, which has been tenanted chiefly by the electrical trade, was assessed by the city for taxation purposes at $400,000.

NEW YORK, N. Y.—New York Railways Company, 165 Broadway, has had plans prepared for alterations and improvements in its station at 13-17 Front street. The work is estimated to cost about $6,000. Severance & Van Allen, 4 West Thirty-seventh street, New York, are architects.

NIAGARA FALLS, N. Y.—United States Light & Heat Corporation, 3215 Highland avenue, has had plans prepared for the construction of a brick and steel addition to its plant, to provide for increased capacity.

ROCHESTER, N. Y.—Bridgeford Tool & Machine Works, Winton Road north, is considering plans for the immediate construction of a power plant at its works, to provide for increased capacity. A. H. Ingle is president.

WARWICK, N. Y.—In connection with the proposed construction of a new institution group for the city of New York, Board of Inebriety, 300 Mulberry street, to cost in the neighborhood of $200,000, and to be located at Warwick, a large power house will be erected. Chauncey Matlock, 30 East Forty-second street, New York, is electrical and steam engineer.

ALLENHURST, N. J. — Atlantic Coast Electric Railway Company is rushing to completion the construction of the local power station, and it is expected that operations will be inaugurated at an early date.

BARRINGTON, N. J.—Delaware & Atlantic Telegraph & Telephone Company has made application to the Borough Council for permission to use the streets and highways of the borough for the installation and maintenance of overhead and underground lines.

BAYONNE, N. J. — Nucoa Butter Company, Fourth street, has recently awarded a contract for the construction of a large power plant, one-story, about 100x100 feet, at its plant, to cost in the neighborhood of $40,000 The American Concrete Steel Company, 31 Clinton street, Newark, is the contractor.

BURLINGTON, N. J.—The board of managers of the State Masonic Home, Jacksonville and Oxhead Roads, has had plans prepared for the construction of a boiler plant at the institution, to be erected in connection with a new cold storage room, the entire work being estimated to cost $35,000.

DOVER, N. J.—New Jersey Power & Light Company has recently commenced the operation of the new 3,500-kilowatt turbine installed in its plant. It is expected that the installation of the new equipment in the addition to the plant recently completed will be finished and the works ready for operation at an early date.

HARRISON, N. J.—The formal opening of the new office building at the plant of the General Electric Company took place on June 14. Employes arranged for a dance and entertainment for the occasion.

HOPEWELL, N. J.—Borough Council is considering plans for the immediate installation of new pumping equipment at the municipal water works, to provide for increased capacity. The new apparatus will be electrically operated.

JERSEY CITY, N. J.—Contract has been awarded by the Erie Railroad Company, 50 Church street, New York, for the construction of the proposed one-story power house at its local works, about 37 x 88 feet. The Robins-Ripley Company, 50 Church street, New York, is the building contractor.

NEWARK, N. J.—Barrett & Company, 49 Vesey street, has awarded a contract to the Frederick Kilgus Company, 13 South Sixth street, for alterations and improvements in its boiler plant, to cost about $5,900.

NEWARK, N. J.—The Board of Education is planning for alterations and improvements in the boiler plants at the Waverly Avenue School, Girls' Vocational School, Hawthorne School, and Summer Place School.

PASSAIC, N. J.—New York Belting & Packing Company, Passaic street, is having preliminary plans prepared for the immediate construction of a one-story power house at its plant, about 60 x 150 feet in size. Lockwood, Greene & Company, 101 Park avenue, New York, are architects and engineers.

TRENTON, N. J.—The Board of Commissioners is having plans prepared for the immediate installation of two new pumping units at the municipal water works, one to be a low lift and the other high lift type of 20,000,000-gallon capacity. The new equipment will be electrically operated.

ALLENTOWN, PA.—Koch Brothers have recently completed the installation of new equipment at their plant, including a 150-horsepower tubular boiler.

CHESTER, PA.—In order to provide adequate facilities for the transportation of workers to the local shipbuilding plants, the Emergency Fleet Corporation has entered into an agreement with the Public Service Commission providing for the construction of a trolley line along the Chester Pike from Chester to Darby. The work, which will be completed in November, is estimated to cost in the neighborhood of $1,000,000.

McKEES ROCKS, PA. — Pressed Steel Car Company, Farmers Bank

building, Pittsburgh, has awarded a contract for the construction of a one-story extension to its power plant at the local works. The structure will be about 40 x 80 feet, and is estimated to cost $18,000. Rose & Fisher, 82 Pennsylvania avenue, Pittsburgh, are the contractors.

PITTSBURGH, PA.—Central District Telephone Company, 416 Seventh avenue, has awarded a contract for alterations in its telephone exchange building on Butler street. A one-story brick addition to the plant will also be erected about 35x42 feet in size Toupet, Beil & Conley, Oliver building, Pittsburgh, are the contractors.

PHILADELPHIA, PA.—Announcement has been made by the Emergency Fleet Corporation, Charles Piez, vice-president, of the proposed construction by the Government of a large power plant for supplying service to the shipbuilding plant at Hog Island and other factories in this vicinity engaged on war contracts. It is said that the new station will have a capacity of about 90,000 kilowatts, and is estimated to cost over $5,000,000.

PITTSBURGH, PA.—The United States Government, Navy Department, has awarded a contract to the Standard Underground Cable Company for power cables to be used at the Brooklyn Navy Yard and electric cable for the Norfolk, Va., navy yard. Contracts have also been awarded to the Westmore Savage Company, Boston, Mass., for electric wire for use at the Philadelphia navy yards, and the Western Electric Company, Inc., of New York, for a quantity of telephone wire.

BALTIMORE, MD.—Baltimore Shipbuilding Drydock Company has awarded a contract for the construction of a boiler plant addition to its works to cost $5,000. Dietrick Brothers, Pleasant and Davis streets, Baltimore, are the contractors.

LANGDON, D. C.—The Corby Company has commenced the construction of the proposed one-story boiler plant, about 20x40 feet in size, at its works. The structure is estimated to cost $10,000 F. L. Wagner, 1413 H street, N. W., Washington, D. C., is the contractor.

ST. JULIAN CREEK, VA.—The United States Government, Navy Department, has had plans prepared for the construction of a local power plant to cost $7,500.

COLLEGE PARK, GA.—Gate City Cotton Mills has recently completed work on the changing of its motive power to electricity.

MACON, GA.—Central Railway of Georgia has awarded a contract to the General Railway Signal Company, Rochester, N. Y., for the installation of new electric interlocking equipment for the operation of electric signals and switches on all tracks entering the Macon terminal yards. The work is estimated to cost $125,000.

BRADENTOWN, FLA.—The city is considering plans for the installation of a new electric-lighting plant.

NORTH CENTRAL STATES.

FREMONT, OHIO—The council is considering ways and means to establish a municipally-owned gas and electric plant to be operated in connection with the Fremont Water Works. Address Councilman William H. Swartz.

DATES AHEAD.

Ohio Electric Light Association. Annual convention, Cedar Point, Ohio, July 10-12. Secretary, D. L. Gaskill, Greenville, Ohio.

National Association of Electrical Contractors and Dealers. Annual convention, Cleveland, Ohio, July 17-20. Secretary, Harry C. Brown, 101 West 40th street, New York City.

Association of Iron and Steel Electrical Engineers. Annual convention, Southern Hotel, Baltimore, Md., September 9-14. Secretary, John F. Kelly, McKeesport, Pa.

Northwest Electric Light and Power Association; affiliated with N. E. L. A. Annual convention, September 11, 1918. Secretary, George L. Myers, Pacific Power & Light Company, Portland, Ore.

International Association of Municipal Electricians. Annual convention, Atlanta, Ga., September 24-27. Secretary, Clarence R. George, Houston, Tex.

American Electric Railway Association. Annual meeting, Atlantic City, N. J., October 8 and 9. Secretary, E. B. Burritt, 8 West 40th street, New York City.

Kansas Public Service Association. Annual meeting, Kansas City, Kans., October 17-19. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kans.

CANNELTON, IND.—Indiana Cotton Mills have had plans drawn for an extensive enlargement of the plant and material is being delivered for the work. The new building will be a two-story concrete structure, approximately 230x130 feet, to accommodate looms in greatly increased numbers. Sanitary lockers, restrooms, electrical fixtures and all modern appliances for labor convenience will be in the new building, which will cost more than $200,000.

INDIANAPOLIS, IND.—Cleveland, Cincinnati, Chicago & St. Louis (Big Four) Railroad Company has announced construction expenditures of approximately $11,000,000. Among the new buildings will be a roundhouse and terminal at Galion, Ohio, at a cost of $1,000,000 and a $500,000-yard at Cincinnati. These improvements will demand a large amount of electrical wiring and installation of fixtures. The company also plans extensive double tracking on several divisions. E. M. Costin, Indianapolis, Ind., general superintendent.

NOBLESVILLE, Ind.—The Noblesville Heat, Light & Power Company is completing plans for the erection of a dam across White River near Noblesville for the purpose of assisting in the operation of a power plant. It is said that engineers have estimated that enough water in the river can be harnessed to provide power to operate about one third of the plant. This will mean a saving of from 5000 to 8000 tons of coal a year. The cost of the improvement is estimated at $100,000. A. R. Holliday, Indianapolis, Ind., is president and general manager.

HOMER, ILL.—A high tension line is being constructed between Homer and Fairmount, a distance of seven miles. Power will be furnished the village of Fairmount by the Homer Electric Light Company upon completion of this work, which will be about August 1.

MOMENCE, ILL.—Metropolitan Telephone & Telegraph Company has applied to the Illinois Public Utilities Commission for a certificate of convenience and necessity to build and operate a line from Momence north through Kankakee, Will and Cook counties to Chicago and Cicero. The company also asks permission to issue $5000 of common stock.

SPRINGFIELD, ILL.—Fifty branch lines are affected by an order of the Illinois Public Utilities Commission giving the Illinois Independent Telephone Company the right to increase its monthly rate by 25 cents a telephone.

SPRINGFIELD, ILL.—Through freight rates over the New York Central Lines has been secured by the Illinois Traction System. The New York Central has always objected to receiving business from the interurban lines, but this order from the Interstate Commerce Commission makes it compulsory. A tentative report establishing joint rates has been handed down by the Commission.

WOODSTOCK, ILL.—Woodstock & Sycamore Traction Company, extending south from Marengo to Genoa and Sycamore will be sold at public auction in August under a decree of foreclosure signed by Judge Carnes of the circuit court of DeKalb county, Illinois.

RHINELANDER, WIS.—Rhinelander Light & Power Company will soon install several thousand dollars' worth of new machinery in its substation here. This will greatly increase the efficiency of the plant.

BEVIER, MO.—Bevier will probably build a power plant of its own instead of getting its power from Macon, Mo.

CHULA, MO.—A corporation headed by the Automatic Electric Light Company of Kansas City, Mo., has been granted a franchise empowering it to install an electric lighting system in Chula, Mo. F. I. Willmont, vice-president and J. M. Stelle, financial representative of the company, are now on the ground and arrangements for starting the construction work will be completed within the next few days

JEFFERSON CITY, MO.—Hays Wood Product Company will construct a $20,000-power house to furnish light and heat for its factory.

PLEASANT HILL, MO.—Green Light & Power Company has recently awarded contracts for the construction of a new electric transmission system from Pleasant Hill to Archie, to cost about $100,000.

RICH HILL, MO.—The city of Rich Hill has voted in favor of issuing $14,000 in bonds for enlarging and improving the water works and electric light plant. Address Mayor Moore.

ST. JOSEPH, MO.—A two-story brick 17x38 power house is to be built at Felix street and 2nd and Main streets at a cost of $4,000.

ST. LOUIS, MO.—Union Electric Light & Power Company has had plans prepared for improvements in its boiler plant to cost about $15,000.

MORAN, KANS.—An agreement has been made between the City Council of Bronson and the same body of officials of Moran whereby Bronson will be supplied with electric current for lighting purposes from the Moran plant. Bronson will build its own lighting system and transmission line from there and connecting with the Moran plant.

TOPEKA, KANS.—An adequate lighting system for parks is one of the subjects under discussion.

WILSON, KANS.—$20,000 in bonds was recently voted to be used for water work improvements.

TOPEKA, KANS.—Kansas towns may vote bonds for a combined light and water plant without a separate bond issue covering each class of municipal utility. That was the decision of the Supreme Court June 8 in the suit of J. H. Lee against Palco, appealed from Rooka County. Mr. Lee brought suit to prevent the city issuing bonds for a combined water and light plant on the grounds that the bond proposition was a duel matter and that the taxpayers should be entitled to vote on each proposition separately. The supreme court in deciding against Mr. Lee simplified municipal improvement work in Kansas to a considerable extent by establishing the rule that water and light are similar important municipal improvements and can be handled as one proposition.

WILLIAMSBURG, KANS. — Williamsburg probably will secure electricity from the municipal plant here and will discontinue its own municipal plant. A tentative contract between Ottawa and Williamsburg has been drafted. The Williamsburg council met June 3 to draw up an ordinance calling a special electric election to vote $12,500 in bonds to build a transmission line to Ottawa.

BEATRICE, NEB.—A petition is in circulation in this city requesting the city commissioners to call a special election for the purpose of submitting to the voters the question of voting bonds in the sum of $100,000 for the construction and equipment of an electric power plant.

BELVIDERE, NEB.—Bonds for a new $7,000 electric plant at Belvidere were approved by the state auditor.

BLAIR, NEB.—The stockholders of the Blair Independent Telephone Company at an adjourned meeting May 25 voted to continue negotiations with the Bell Telephone Company for the purchase of its Blair plant and connecting country lines. E. C. Hunt of Melmo, Neb., was here May 26 with a view of buying both plants and consolidating them.

SOUTH CENTRAL STATES.

HAZARD, KY.—Electrical Supply & Repair Company is considering plans for the construction of a plant to cost approximately $20,000, to be used as a general electrical repair establishment.

WEST POINT, KY.—West Point is without electric light power. Crutcher and Starks will install an electric light plant for both interior and exterior lighting.

CHENEYVILLE, LA.—The question of issuing bonds for the construction of municipal light and water system will be submitted to the voters. Address N. H. Carnahan, mayor.

RAYNE, LA.—The sum of $35,000 has been voted in bonds to improve the light and water system. Address the mayor.

CYRIL, OKLA.—Election to vote $5,000 bonds for water works carried recently. A. L. Pettyjohn, town clerk.

OKMULGEE, OKLA.—Bonds have been sold to Q. W. McNeir & Company, Chicago, for water works and sewer improvements. Water improvements to cost $385,000 include additional reservoir pumping station, mains and lateral extensions. Burns & McDonnell, 402 Inter-State building, Kansas City, Mo., engineer.

POTEAU, OKLA.—The $95,000 bond issue for water bonds has been sold to Spitzer Rorick, of Toledo, Ohio. Contract for the improvements will be let soon.

BRISTOW, OKLA.—Application of the Oklahoma Gas & Electric Company for the use of certain highways was presented recently and application heard. The county commissioners granted the application. C. W. Dunbar, deputy county clerk.

WAURIKA, OKLA.—Piersol Brothers, of Oklahoma City, have bought the bonds, which were voted some time ago for improving the city's water system.

BRACKETTVILLE, TEX. — The council is planning to improve the municipal electric plant.

GALVESTON, TEX.—It was announced by officials of the Brush Electric Company June 5 that repairs were progressing rapidly on those parts of its plant at Twenty-sixth and Postoffice streets, which were recently slightly damaged by the fire June 4. The damage was estimated by W. R. Phipps, general manager of the company, at about $75,000.

YOAKUM, TEX. — Commissioner Orth, a member of the committee which was appointed some time ago to look into the matter of extending a franchise to the Yoakum Power, Light & Water Company, which was contemplating making extensive improvements rendered a final report to the board after taking the matter up with Manager Stephenson, who stated to Mr. Orth that it would be more agreeable to him that the franchise proposition be discontinued. The report was accepted.

WESTERN STATES.

SHELBY, MONT.—Miracle Concrete Company was awarded contract for street lighting by the town council at $5120.

EVERETT, WASH.—The council will place before the voters the question of installing a municipal light and power plant. Address city clerk.

AUBURN, WASH.—Ordinance has been passed by city council granting franchise to the Valley Gas Company to erect, operate and maintain a system of electric transmission lines over certain streets of the city.

CHEHALIS, WASH.—Voters of this place have again rejected the light and power franchise ordinance asked for by O. E. Anderson.

SEATTLE, WASH.—Public utilities committee of the city council has recommended a further appropriation of $15,000 for preliminary examination of the Gorge Creek power site on the Skagit river and authorizing the city engineer to do the work. An estimate of the cost of the proposed work was submitted by A. H. Dimock, city engineer, and provides an outlay as follows: Gorge development, road, railway and transmission line surveys, $2,000 each month for three months, $18,000, diamond drilling at gorge, $15,000, opening temporary road, $25,000, etc.

TACOMA, WASH.—City council authorized the light department to purchase $20,000 worth of electric goods to be sold to consumers of the city.

MARYSVILLE, CAL.—Marysville-Nevada Light & Power Company has awarded a contract for the construction of a new reinforced-concrete dam across the Yuba River at Bullard's Bar, about 40 miles from Marysville. The dam will be about 150 feet long, 30 feet high, 30 feet wide at the bottom and 20 feet at the top. Oscar Ford, Riverside, is the contractor.

MONTEREY, CAL.—The city council is having plans prepared for extensions in its electrolier system on Main street.

FOREIGN TRADE

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

ELECTRICAL PLANT (27,106).—The executive engineer of public works of a city in India desires to purchase an electrical plant, consisting of motors, transformers, etc. Further information and complete specifications may be had on application to the bureau of its district and co-operative offices.

ELECTRIC LAMP MATERIALS (27,098).—A man in Argentina wishes to purchase machinery and all kinds of materials necessary for the manufacture of electric lamps, especially copper wire of 35 mm., 50 mm., and 60 mm.; also tungsten filament wire, leading wire, anchor support, phosphoric acid, acid for polishing lamps and for glazing same. Correspondence should be in French, Italian or Spanish.

PROPOSALS

CABLE.—Bids will be received at once for 2000 feet of No. 8 and No. 10 B. & S. copper, steel armored cable, twin-conductor. Consulting Engineer F. M. Conlee, Washington building, Madison, Wis., has prepared plans.

PORTABLE DESK LAMPS.—Bids will be received July 5 for supplying the various federal buildings, marine hospitals, quarantine stations under the control of the Treasury Department, Washington, D. C., portable desk lamps during the fiscal year ending July 30, 1919. Address James A. Wetmore, acting supervising architect.

LAMP FIXTURES.—Bids will be received on July 3 by the Department of Gas and Electricity, Chicago, Ill., for 1000 lamp fixtures complete, according to plans and specifications. The specifications include ornamental cast-iron street lighting fixtures for gas and electricity. Address William G. Keith, Commissioner, City Hall.

Trade Activities

Premier Rubber Insulation Incorporates—Dr. Charles W. Burrows Establishes Research Laboratory—Special Catalogs

Pneuvac Company, Worcester, Mass., manufacturer of electric vacuum sweepers, recently established a branch office in the Furnisher Exchange building, San Francisco, Cal. F. W. Binnem is the Pacific Coast manager.

Wadsworth Electric Manufacturing Company, manufacturer of externally operated switches, Covington, Ky., announces its recent incorporation under the laws of the state of Kentucky with an authorized capital of $100,000. This company is producing the line of Compro safety switches and combined meter protectors and service switches, which have been described in a recent issue of the ELECTRICAL REVIEW.

Packard Electric Company, Warren, Ohio, recently ran in leading local newspapers an advertisement making an appeal for patriotic workers to help produce more goods for Government trucks and airplanes for our armies; also tractors for farm use, and was productive of the most gratifying results. Many volunteers have applied and are now busy at their respective benches or machines. Among the first to apply was the wife of the president of the Packard Electric Company, who has become so proficient that she has been placed on piece work and rates favorably with the older workers. The Packard company is probably the first company that has called for this class of help in this manner and such a response is certainly gratifying. President Wolcott maintains that it is only the beginning of a movement which must ultimately become the rule rather than the exception.

Edison Storage Battery Company has established a new sales office in Kansas City, Mo., appointing Benjamin F. Eyer as resident manager. Mr. Eyer has had a wide and varied engineering experience in the Middle West. From 1902 to 1913 he was head of the electrical engineering department of the Kansas State Agricultural College, where he gained a wide acquaintance as a consulting engineer, acting for both municipalities and private corporations. In association with several business men, Mr. Eyer, in 1908, purchased and developed the Manhattan Ice, Light & Power Company, and is at present interested in the Marshall County Power & Light Company, which he developed in 1914. In 1916 he opened an office in Kansas City as consulting engineer, appraising and reporting on Middle West utilities for eastern syndicates. The Middle West is full of promise for the development of uses for the Edison storage battery, and Mr. Eyer's extensive acquaintance in this field inspires the belief that this section of the country will be developed as never before.

John H. Barker, 95 Liberty street, New York City, was recently appointed representative of the Bodine Electric Company, Chicago, in New York territory.

Reno-Karthor Electric Company, Cincinnati, Ohio, has appointed John H. Barker of New York City, handling electrical equipment for factories, as sole agent in the metropolitan district for the Reliance motor-driven swing saw manufactured by the company.

Dayton Storage Battery Company, 140 North Main Street, Dayton, Ohio, has been purchased by B. T. Tullis and O. D. Houck, and plans are now being made to greatly improve the equipment and increase the working force, thus greatly increasing their efficiency. Expert repairing and recharging of all makes of batteries is a feature worthy of consideration. They will also continue, to act as sole distributor for Montgomery county for the well-known U. S. L. batteries.

National Lamp Works of General Electric Company, Cleveland, Ohio, through its engineering department, has issued a wiring chart for use in selecting the proper size of wire for country-house lighting installations. The chart, together with installation suggestions for country home lighting, is printed on a white card of convenient pocket size and is contained in a neat protecting envelope. Electrical contractors and dealers who are engaged in the installation of country-home lighting outfits will find this chart of great convenience and a valuable aid in avoiding the use of too small wire which is the cause of considerable trouble in plants of this character.

Premier Rubber Insulation Company, Dayton, Ohio, announces its recent incorporation under the laws of Ohio, to engage in the manufacture of Premier insulation products. The new concern has an authorized capital of $100,000, of which $60,000 is common stock and $40,000 preferred. On property located in North Dayton a modern plant was erected and completed on April 1. The plant is a one-story building, 68x100 feet in size, and has its own power house. The floor space is divided into three main departments—tool room, hard rubber molding and vulcanizing and Bakelite molding. The plant has been in operation since May 1 and already operates day and night shifts. The company will specialize in hard rubber products, comprising a line of battery jars and covers, distributors and various other rubber insulations used on airplanes and automobiles. In the Bakelite department, molded insulation of every description is being produced of which its specialty is the most complicated kind of insulation used for starting, lighting and ignition systems.

Dr. Charles W. Burrows, formerly of the Bureau of Standards, Washington, D. C., has established a laboratory at Grasmere, Borough of Richmond, New York City, for the experimental study of problems relating to the magnetic characteristics of material and apparatus. The initial laboratory equipment provides very fully for all lines of magnetic research and has modest facilities for such chemical and metallurgical investigations as may be required during the course of the study of magnetic material and phenomena. While the work will be confined to investigations along magnetic lines it will cover several phases. Attention will be paid to the design, procurement and installation of magnetic testing apparatus suited to the particular requirements of the individual manufacturers. This will include the instruction of the testing operator as well as the maintenance of a continuous inspection and advisory service so as to reduce to a minimum the difficulties inherent in commercial testing and research and to aid in the solution of new problems as they arise.

The magnetic analysis of steel and steel products with a view to the determination of homogeneity and uniformity of output as determined by mechanical and thermal treatment will form one of the important activities. The importance of this work in the determination of the shop conditions which will yield the desired homogeneity and uniformity is gradually being realized by the makers of high grade steel products whose excellence depends largely upon uniformity of the raw material and upon scientifically determined and carefully carried out heat treatment. Here also the design and installation of suitable equipment, together with suitable instruction and service facilities, are needed.

A third phase of the work includes the investigation of apparatus and materials. A study, both theoretical and experimental, of the properties of iron and steel and of electromagnetic apparatus, which will yield reliable data upon which to base the details of design and manufacture, may be expected to lead to a perfection of product and excellence of performance greatly to be desired. The design and development of new apparatus to meet specified requirements will also be undertaken. This phase of the work will include the development of apparatus which has not previously received careful scientific consideration. In general, service will be rendered to manufacturers by the improvement of their product, to inventors by the practical realization of their ideals, and to financiers by reliable information as to the possibilities of a proposition under consideration for investment.

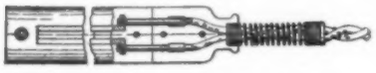
Recent Patents

Selected and Summarized by Albert Scheible, Patent Attorney, 79 West Monroe Street, Chicago, Illinois

A series of brief comments on some of the recently issued electrical patents which appear to be of particular interest to our readers, the number after each heading being that of the United States patent to which the summary relates. Any correspondence regarding such patent matters should be sent direct to Mr. Scheible at the above address.

Rotary Spark Gap (1,265,959).—In the apparatus designed by Robert C. Richter, of New York City, the electrodes are not only rotated in opposite directions, but can also be adjusted to vary the point in their travel where they pass each other.

Electric Water-Purifier (1,264,593).—Electrodes in a convenient and portable mounting are shown in this patent, assigned by Edward M. Barnes of Hastings, Mich., to the American Utilities Co., of St. Joseph, Mich.



1,264,593.—Electric Water-Purifier.

Brush-Mount for Electric Motors (1,265,873).—For a simple mounting, Joseph Berg interposes a spring between the carbon brush and the bolt which supports the tubular holder in which the brush slides. The patent was assigned to the Stewart- Warner Speedometer Corporation, of Chicago.

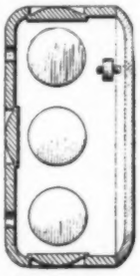
Lightning Protector (1,266,175).—A cupola-shaped metallic terminal having a large radius of curvature and a smooth outer surface is connected with a grounded conductor of small self-induction and resistance, according to this patent to Nikola Tesla, of New York City.

Electric Meter (1,266,347). — To equalize the effects of local magnetic disturbances on the two armatures of a motor meter, Elihu Thomson, of Swampscott, Mass., places a magnetic member near these armatures and mounts an initial energy coil on this magnetic member. The patent stands assigned to the General Electric Co.

Fusible Protector for Electric Utensils (1,264,868).—To prevent electric utensils from being overheated, Frederick E. Carlson, of New Britain, Conn., uses a spring clip for a part of the electric circuit on the utensil itself, and holds the fingers of the clip in their normal relation by means of a fusible rivet. When the device is overheated, this rivet melts and allows the clip to drop off its connections.

Electrical Heating Unit (1,265,433).—To make a heating unit which will support the article to be heated, Ransom W. Davenport, of Detroit, starts by molding a mixture of ground cork and infusorial earth into a block having grooves for receiving the heating coils, and eliminates the cork by baking the block. He then renders the surface of the block nonporous by coating it with portland cement or a fusible clay. The patent is assigned to the Detroit Stove Works.

Outlet Box (1,264,450).—To avoid objectionably disposed rough edges in outlet boxes, Oliver T. Sweet, of St. Louis, makes the knockout plugs larger in diameter than the recesses

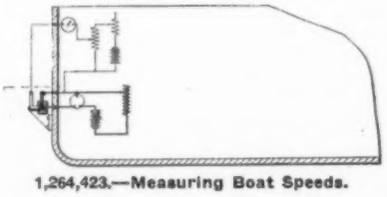


1,264,450.—Outlet-Box Knockout.

out of which they are broken. This is said to produce a flaring cleavage which leaves the full size intended opening.

Welding Transformer (1,266,084).—The transformer casing is employed as part of the secondary circuit of a transformer for use in electric welding, according to this patent, assigned by Edmund J. von Henke to the Thomson Electric Welding Co.

Measuring Boat Speeds (1,264,423).—The electric speedometer devised by Ralph W. E. Moore, of Wilkinsburg, Pa., comprises a thermocouple immersed in the water, means for maintaining one junction of the couple at a predetermined temperature,



1,264,423.—Measuring Boat Speeds.

and means for measuring the difference in temperature between the hot and cold junctions of the thermocouple. This temperature difference then measures the speed of the boat.

Illuminated Traffic-Button (1,265,386).—A hemispherical glass bumper covers a box set into the roadway and containing an incandescent lamp. Patented by William B. Richards, of Pomona, Cal.

Flashlight Battery Rheostat (1,264,520).—To compensate for the varying voltage in dry batteries between those

1,264,520.—Flashlight Rheostat.

of new and of old cells, Major E. Holmes, of Lakewood, Ohio, mounts a compression rheostat in one end of the battery casing and adjusts the compression by means of the screw cap of the casing. The patent was assigned to the National Carbon Company.

Removing Battery Terminals (1,265,980).—To remove battery terminals, Ernest W. Weinmann, of Chicago, cuts an annular groove through the terminal concentric with the original battery post, disassembles the batteries and burns fresh terminals on the posts after reassembling the batteries.

Plastic Composition (1,265,855).—As a substitute for rubber and other flexible materials, Charles B. Wood, of Charleston, W. Va., impregnates a fibrous material with shellac made into a thick paste with alcohol, compresses the mixture and saturates the pressed material with formaldehyde.

Wall Box for Electrical Apparatus (1,265,744).—For mounting switches or the like, Clair C. Canfield, of Crafton, Pa., provides brackets upon the sides of the box for securing the latter to the wall. The brackets slide on the box and can be adjusted by means of screws accessible from the front of the box.

Electrical Ground (1,266,209).—A carbon grounding rod is supported by a mass of hygroscopic material and connected to a metal rod, the rod and its connection to the carbon being covered with insulating material to keep these parts out of contact with the moisture of the earth. Patented by Thomas W. Byrne, of Boston, Mass.

Leading-in Conductors (1,265,665).—For sealing conductors into the walls of incandescent lamps, rectifiers or the like, Richard Jacoby first treats the conductors so that each will have a portion of a lower coefficient of expansion than the glass disposed between two portions of the same coefficient of expansion as the glass. This patent was assigned to the General Electric Co.

Men in Service

Stacey B. Lindsley Receives Commission—A. S. McAllister Joins Control Bureau—Ordnance Department—Honor Rolls

B. BADRIAN has resigned his position with the Hurley Machine Company, Chicago, to enlist in the U. S. Navy and is now stationed at San Pedro.

CENTRAL ELECTRIC COMPANY, Chicago, Ill., one of the largest electrical jobbing houses in the Central West, has 39 names on its roll of honor at the present time.

LEO MCKEOUN of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has enlisted in the navy as an apprentice and is now on duty at the Great Lakes Naval Training Station.

ENGINEERS' CLUB OF PHILADELPHIA now carries on its roll of honor the names of 236 members of the organization who have been called into service in the army or navy of the United States, and among these are many who have earned commissions of high rank.

ARTHUR W. WARNER, head of the real estate department of the Interborough Rapid Transit Company, New York City, has obtained an indefinite leave of absence to enter Government service to assist in the buying, commandeering, and valuation of property for the army and navy.

A. S. MCALLISTER has gone to Washington, D. C., as assistant to Major Thompson in the Progress Section of the Control Bureau of the Ordnance Department. Before going to Washington, Dr. McAllister had been active in New York in committee work of engineering societies, relative to war matters.

FIRST LIEUTENANT ROBERT MONTGOMERY, formerly manager of the commercial department of the Louisville Gas & Electric Company, is now stationed at Camp Sherman, Chillicothe, Ohio, with his regiment, the 334th Infantry. Lieutenant Montgomery recently received several weeks special instruction in artillery work at Fort Sill, Oklahoma.

STACEY B. LINDSLEY, formerly secretary and engineer of the Western Wood Preserving Company, one of the Lindsley Brothers Company subsidiaries, has been commissioned first lieutenant in the Signal Reserve Corps, Aviation Section, and appointed adjutant of the First Training Brigade, stationed at Kelly Field, San Antonio, Tex.

ASSOCIATION OF IRON & STEEL ELECTRICAL ENGINEERS carries on its roll of honor the following names of members in army and navy service with the United States and her allies: J. H. Albrecht, J. M. Andrews, L. R. Berkeley, H. E. Billington, William Van C. Brandt, J. O. Corbett, S. C. Eaton, Elmer H. Fisher, C. D. Gilpin, W. R. Glasgow, Stanton S. Hertz, C. A. Huebner, P. W. Jones, C. C. Lynde, G. J. Mallon, D. Martignone, A. G. Montgomery, C. J. Mundo, A. M. MacCutcheon, E. O. Oeters, C. O. Phillips, F. E. Riling, John Sherman, John Simonich, Frank P. Singer and A. B. Starr.

ROLL OF HONOR.

The electrical industry, perhaps to a greater extent than any other industry, has answered the call of the Nation for Men. As this is a war of engineers, naturally the technically trained men in the electrical industry have been in great demand and they have responded with splendid patriotism. Many of the large utility and industrial corporations have assigned men for Government service aside from those who have voluntarily entered or been called for service.

THE ELECTRICAL REVIEW *will welcome news concerning men who have entered the service or who are engaged in any patriotic duties.*

H. H. LYONS, manager of the Ordway division of the Arkansas Valley Railroad, Light & Power Company, on June 14 left Ordway for the Fort Collins College for special training for war service.

ED. RYAN, formerly of the credit and collection department of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has enlisted in the Radio Section of the Great Lakes Naval Training Station.

LIEUTENANT W. D. MEL, formerly connected with the Pacific Gas & Electric Company in San Francisco, has been transferred from Fort Monroe, where he has been stationed, to Presidio, Col.

C. D. SE CHEVERELL, who for 12 years has been connected with the Superior Water, Light & Power Company, Superior, Wis., has tendered his resignation as secretary of the company and will engage in army Y. M. C. A. work abroad.

A. J. DE ST. AUBIN of the engineering department of H. M. Byllesby & Company, Chicago, has left for Fort Leavenworth where he will receive additional training preliminary to securing a commission in the United States Army. ALFRED PALM, also of the engineering department, has entered the Ensigns' School of the U. S. Navy, Chicago.

HARRY S. KRAMER, formerly combination man of the Mountain States Telephone & Telegraph Company at Pueblo, Colo., has graduated from the Third Officers' Training Camp at Camp Lewis, Washington, which closed on April 20, and is now eligible to appointment as a second lieutenant. Mr. Kramer has left for Camp Jackson, South Carolina, where he will await the call to active war duty.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, Chicago, Ill., in the June issue of the Reminder devotes several pages to its roll of honor. The list bears the names of 2039 former employes of association members who are now in the Army or Navy.

FRANKLIN INSTITUTE of the State of Pennsylvania in the June number of its Journal devotes several pages to its roll of honor, showing the names of 124 members who are in active military or naval service and those who are serving the Government in civilian capacities. Of this number, 83 are members in active military service and 41 are doing civilian work for the Government.

W. J. GRAMBS, formerly superintendent of light and power of the Puget Sound Traction, Light & Power Company, Seattle, Wash., was recently appointed supervisor of the Sea Training Bureau of the United States Shipping Board for the Pacific Northwest. Mr. Grambs entered Government service on September 1, 1917, and since that time has been in charge of the navigation schools in Seattle, Tacoma, Portland and Bellingham and the marine engineering school at the University of Washington. In his new position Mr. Grambs will have complete charge of the receiving station in West Seattle and the training ships *Iroquois* and *Chippewa*, which were recently taken over by the Government.

Obituary.

MAJOR EUGENE WILSON CALDWELL, Medical Reserve Corps, United States Army, died at the Roosevelt Hospital, New York City, on June 20, as the result of burns he had received many years ago while experimenting with X-ray inventions. He was one of the most noted X-ray authorities in the world, and had only recently completed, under the direction of Surgeon-General Gorgas, an appliance for stereoscopic fluoroscopy especially adapted to war needs. Major Caldwell was born at Savannah, Mo., December 3, 1870, and in 1892 received the B. S. degree at the University of Kansas. He was a special student at the College of Physicians and Surgeons at Columbia in 1898, took the M. D. of the Bellevue Hospital Medical College in 1899 and in New York University in 1905. His experiments in marine telegraphy were made for the United States Lighthouse establishment and continued from 1893 to 1895. He then became assistant in the engineering department of the New York Telephone Company. He ceased work for the telephone company in 1897 and devoted himself almost entirely to X-ray work. He was chiefly noted for his work with the Roentgen rays and their practical uses in diagnosis, although he also had fame as an experimental expert in marine telegraphy. A military funeral was held June 23, at New York City.

Personal

Dr. C. W. Burrows Leaves Bureau of Standards—A. Huetter Becomes Vice President Premier Rubber Insulation

C. W. WALLACE, manager of the Niagara Light, Heat & Power Company, Tonawanda, N. Y., has become manager of the Atlas Chemical Company, Toledo, Ohio.

ERNEST B. HUMPSTONE, connected with Chisholm & Chapman, of New York, has been elected a director of the Crocker-Wheeler Company, manufacturer of electric motors, etc., Ampere, N. J.

A. P. C. SCHRAMM, who for the past five years has been associated with the Klaxon Company, Newark, N. J., as chief engineer, has established himself as a consulting engineer with offices located at 276 Canal street, New York City.

E. M. RAETZ, of the Foster-Raetz Electric Company, Rochester, Minn., has associated himself with Paul D. Richardson, 239 Plymouth building, Minneapolis, Minn., in the sale of Stromberg electric time systems and the Autocall signal system for the Northwest; the demand for these well known lines being active just now in keeping with the present trend toward conserving time and eliminating waste of their use.

DR. CHARLES W. BURROWS, associate physicist of the Bureau of Standards, Washington, D. C., in charge of the magnetic section of that institution, has resigned and will take up the work of commercial research and consultation, with laboratories equipped for research on problems involving magnetic materials and apparatus located at Grasmere, Borough of Richmond, New York City. Dr. Burrows has rather unusual qualifications for the work he is about to undertake. In 1905 he received the degree of Doctor of Philosophy from the University of Michigan. Since then he has been a member of the scientific staff of the Bureau of Standards at Washington, D. C. During this period he has reduced practical magnetic testing to an exact science. The Burrows magnetic permeameter is the standard method for commercial as well as for precise magnetic measurements in this country. His greatest achievement has been in the discovery and development of the science of magnetic analysis, and by the application of this science it is possible that the mechanical methods of testing iron and steel will be revolutionized. By no other means is it possible to identify or differentiate steels of closely similar characteristics. Much of the work of Dr. Burrows has been described in the publications of the Bureau of Standards and in the technical presss of the country. In addition to his university doctorate Dr. Burrows is a Fellow of the American Institute of Electrical Engineers, and a member of important committees of the National Research Council, National Safety Council, Railway Signal Association and American Society for Testing Materials.

GEORGE WEHRLE, superintendent of the Denver Gas & Electric Light Company, has become manager of the Niagara Light, Heat & Power Company, at Tonawanda, N. Y.

FRANK L. FOX, for the past four years manager of the Southern Public Utilities Company at Thomasville, S. C., has been transferred to the Chester (N. C.) branch of which he will be manager.

CHARLES WALKER, assistant engineer for a number of years at No. 3 steam generating station of the Rochester Railway & Light Company, Rochester, N. Y., has accepted a position as superintendent of the Hornell Electric Company, Hornell, N. Y. Charles E. Hague, who has been connected with the company's laboratory since November, will succeed Mr. Walker as engineer.

THOMAS HENRY, formerly connected with the Toronto Electric Light Company, has engaged in business as a consulting engineer on power proposals, including both construction and operation, with offices located at 58 Front street, West, Toronto. Mr. Henry will also act as a machinery broker for power equipment of all kinds—steam, electric and hydraulic. He has had a wide experience in this field of work, having designed and built the Erindale hydro-electric plant of the Interurban Electric Company, and, as chief engineer, operated this plant for 12 years.

ALBERT GOLDMAN, assistant general commercial manager of the New York Edison Company, Bronx District, served as parade manager of the American Red Cross Parade which was held in the Bronx recently. About 20,000 people participated, including the State Guard and Naval Reserve Forces, nurses representing the various branches of the service, Girl and Boy Scouts, Y. M. C. A., police reserves, school children and others. Mr. Goldman was also in charge of the public collections taken on the streets and in the theaters in the Bronx District in which close to $65,000 was realized.

A. HUETTER has resigned his position as head of the Delco Bakelite department of the Dayton Engineering Laboratories Company, Dayton, Ohio, to become vice-president and general manager of the Premier Rubber Insulation Company, of which he is the founder. Mr. Huetter is a well known efficiency engineer and was for a number of years superintendent of the Boonton Rubber Manufacturing Company, Boonton, N. J. His combined experience as an efficiency engineer, executive and his specialized knowledge in the field of electrical insulation will qualify him for properly conducting the management of the new enterprise and render efficient service in molded electrical insulation, including both hard rubber and condensation products.

D. CLINTON GROVE, has resigned his position as advertising manager of the Diehl Manufacturing Company, manufacturer of electrical apparatus, Elizabeth, N. J., to become connected with the advertising department of the Ingersoll Rand Company, New York City.

A. N. ANDERBERG, whose association with the Superior Water, Light & Power Company, Superior, Wis., extends over a period of 20 years, was elected secretary of the company at a recent meeting of the directors. Mr. Anderberg succeeds to the position made vacant by the resignation of C. D. Se Cheverell, who will engage in Y. M. C. A. work. He is also treasurer of the company and will continue with his duties in that office.

ISAAC W. GROSS has resigned his position in the motive power department of the New York Railways to become New York manager of the General Devices & Fittings Company. Immediately after his graduation from Harvard University in 1911, with the degree of electrical engineer, Mr. Gross became connected with the New York Railways. At the time of his resignation and some years prior, he was in charge of all electrical investigations, and has also had charge of all the electrical testing in the department and general company illumination.

Obituary.

P. T. GLIDDEN, for several years manager of the Northern States Power Company, St. Paul division, died on June 18, after a lingering illness. Mr. Glidden became associated with the Byllesby interests at the time of the consolidation of the gas and electric companies of Louisville, Ky., into a single operating unit. Subsequently he was made manager of the company's electric interests at St. Paul, Minn., where he very soon became identified with the business interests of the community and state. He served two terms as president of the St. Paul Association of Commerce and one year as president of the Minnesota Electrical Association, 1913-14.

Mr. Glidden was born in Massachusetts in 1870, and educated in the public schools of South Carolina. He began his business career with the Holtzer-Cabot Electric Company in Boston, in 1889. Subsequently he was accociated with the New York Edison Company; Ohio Brass Company; Binghamton Light, Heat & Power Company, Sayre Electric Company, Sayre, Pa., of which he became vice-president and general manager; Eastern Pennsylvania Power Company, vice-president and general manager; Louisville Lighting Company, manager, and finally manager of the St. Paul division of the Northern States Power Company, which position he occupied until his death.

Financial News

Public Utility Securities.

The firmness in public utility securities a week ago, due to the apparent attitude of the War Finance Corporation, later was weakened by the tendency of that corporation to demand the supervision of dividends where advances are made; and by repeating an earlier warning that, except in cases of the greatest urgency, it will make no loans direct. The enforced extension of two-thirds of Brooklyn Rapid Transit notes has spread the belief that perhaps maturities of other utility corporations which are earning ample surplus and should enjoy high credit rating must be extended.

Practically the same situation prevails among the utilities as was common to the railroads before they were given rate increases. The same reasons that justified rate increases for steam roads are reasons why nothing but rate increases can effectually help utility companies. Since September 1, 1917, increased rates for utility service have become effective at 297 communities served by the following properties managed by H. M. Byllesby & Co.: Fort Smith Light & Traction Company, Mobile Electric Company, Northern States Power Company, Oklahoma Gas & Electric Company, Ottumwa Railway & Light Company, Puget Sound Gas Company, San Diego Consolidated Gas & Electric Company, Tacoma Gas Company, Western States Gas & Electric Company.

BYLLESBY ELECTRIC PROPERTIES.

All Byllesby electric properties, reporting for the week ending June 15, show the following new business gains (net): Sixty-five customers with 148 kilowatts of lighting and 738 horsepower in motors. New business contracted for, but not yet connected, includes 1,000 customers with 382 kilowatts of lighting and 446 horsepower in motors. Electric energy output was 15 3 per cent greater than during the corresponding week last year.

Aurora-Elgin Defers Interest.

Announcement made by the Aurora, Elgin & Chicago Railroad Company that interest on the $3,079,000 first and refunding mortgage bonds due July 1 will be deferred. Officials of the company say it is hoped to make the payment prior to January 1, next, this hope being based on the expectation of favorable action on the company's application for higher rates for service.

The postponement of the interest payment was not surprising, in view of the company's recent earnings. For the first three months of 1918 it failed to earn its interest charges by $5,911 and, after depreciation and amortization charges, the deficit for the quarter was $13,020. The bonds bear interest at the rate of 5 per cent.

Increased Rates Solve Utility Problem.

Charles G. Dawes, of Chicago, speaking before the twelfth annual meeting of Group 3 of the Illinois Bankers' Association declared that the future financial solvency of the public utilities of the country depends upon increased rates for their products and their services. The utilities, Mr. Dawes declared, are paying war time prices for materials, labor and betterments, with incomes based upon peace prices. "What this means in relation to the general financial conditions in the United States," he said, "may be inferred from the fact that there is outstanding upon public utility securities in the United States a bonded indebtedness amounting to $5,143,000,000."

San Joaquin Light Offering.

The National City Company is offering at 95 and interest, yielding approximately 6 per cent, a block of first and refunding 6s, series C, of the San Joaquin Light & Power Corporation, due August 1, 1950. Earnings of the company for the year ended April 30 were as follows: Gross, $2,199,782, net after taxes, $1,193,641; total income, $1,268,109.

Public Utilities Committees Named.

James N. Wallace, Thomas W. Lamont, Charles H. Sabin and Frederick Strauss of New York have been appointed as a committee by W. P. G. Harding, managing director of War Finance Corporation, to consider the question of public utility companies obtaining advances from the corporation. Appointment of committee is the result of the recent conference held by the corporation. There is talk in New York banking circles of the organization of a $100,000,000 corporation especially to finance public utility enterprises during the war period.

New Telephone Bonds to Be Sold.

The holders of the New Telephone Company's first mortgage bonds, due June 30, 1918, have been notified that arrangements have been made by the Indianapolis Telephone Company, successor to the New Telephone Company, by which the above named bonds, so far as the same have not already been extended, will be purchased at par on or after June 30, 1918, and extended by the purchasers for five years. Until and after July 10, 1918, the extension privilege will be given the present holders of the bonds. Those not desiring to extend their bonds should send them to the Fletcher-American National Bank of Indianapolis, or to J. P. Morgan & Company, 23 Wall street, New York City, and upon such presentation the sum of par will be paid for the bonds. The coupons due July 1 will be paid in the manner customary with the company.

To Offer Louisville Gas Bonds.

A syndicate is being organized by the Harris Trust & Savings Bank, Chicago, the Guaranty Trust Company, New York, and E. H. Rollins & Sons, to offer $10,500,000 Louisville Gas & Electric Company first and refunding mortgage five-year 7 per cent bonds. These bonds will be secured by a first lien on more than 75 per cent of the entire property of the company and are subject only to $3,119,000 underlying bonds on the balance of the property. The company and its predecessor companies have been in successful operation for 80 years. The gross and net earnings, as officially reported, are the largest in the company's history. The bonds are issued to retire the company's 6 per cent bonds, maturing July 1, 1918, and will be offered to the public at 98 and interest, yielding about 7½ per cent.

American Telephone & Telegraph Syndicate to Underwrite Bonds.

The syndicate which will underwrite the proposed issue of $44,500,000 seven-year 6 per cent convertible bonds of the American Telephone & Telegraph Company will consist of J. P. Morgan & Company, Kidder, Peabody & Company, Kuhn, Loeb & Company, First National Bank of New York, Harris, Forbes & Company, Lee Higginson & Company and National City Company. The new issue of American Telephone convertible bonds will run seven years, and bear interest at the rate of 6 per cent per annum. Stockholders, at a meeting to be held July 3, will be asked to authorize an issue not to exceed $50,000,000 in amount. Bonds are to be convertible into the present stock of the company on the basis of $106 of bonds for one share of stock. Conversion period will begin two years after date of the bonds, and run until maturity. The rights will expire July 15, on which date the first payment of 10 per cent will be due. The balance of the subscription will be payable in two approximately equal statements on August 1 and October 1. A 7 per cent return on the new convertibles as reported from New York is somewhat higher than yield basis on outstanding collateral trust 4s, due July 1, 1929. Bonds are selling to delivery at 81, at which price the return is about 6.42 per cent. They are secured by deposit of bonds and stocks of subsidiary companies, while the new 6s will have no collateral or mortgage security. The price at which the bonds will be offered has not yet been definitely settled, but, according to Boston advices, it will be around 94.

Northern Ohio Traction Bond Plan.

The Ohio Public Utilities Commission has given the Northern Ohio Traction & Light Company permission to issue $900,000 of 5 per cent bonds and $180,000 of preferred stock.

Dividends.

Republic Railway & Light Company has declared a quarterly dividend of 1 per cent on common stock and of 1½ per cent on preferred stock, payable July 15 to stock of record July 1.

Commonwealth Edison Company has declared a quarterly dividend of $2 a share, payable August 1 to stock of record July 15.

Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 87½ cents a share on preferred and common stocks, the preferred payable July 17 and the common July 31, both to stock of record June 29.

New England Telephone & Telegraph Company has declared the regular quarterly dividend of 1¾ per cent, payable June 29 to stock of record June 19.

Detroit Edison Company has declared the regular quarterly dividend of 2 per cent, payable July 15 to stockholders of record July 1.

Duquesne Light Company has declared the regular quarterly dividend of 1¾ per cent on preferred stock, payable August 1 to stock of record July 1.

Adirondack Electric Power Company has declared the regular quarterly dividend of 1½ per cent on preferred stock, payable July 1 to stock of record June 15.

Montreal Light, Heat & Power Company has declared a dividend of 2 per cent, payable August 15 to stock of record July 31.

Virginia Railway & Power Company has declared the regular semi-annual dividend of 3 per cent on preferred stock, payable July 20 to stock of record July 1.

National Light, Heat & Power Company has declared the regular quarterly dividend of 1¼ per cent on preferred stock, payable July 1 to stock of record June 26.

Pacific Telephone & Telegraph Company has declared the regular quarterly dividend of 1½ per cent, payable July 15 to stock of record June 29.

Public Service Company of Northern Illinois has declared a quarterly dividend of 1⅞ per cent on common stock, and a dividend of 1½ per cent on preferred stock, both payable August 1 to stock of record July 15.

California Electric Generating Company has declared a quarterly dividend of 1½ per cent, payable July 1 to stock of record June 22.

Harrisburg Light & Power Company has declared a quarterly dividend of 1½ per cent on preferred stock, payable June 30 to stock of record June 10.

Edison Electric Illuminating Company has declared the regular quarterly dividend of 3 per cent, payable August 1 to stock of record July 15.

Providence Telephone Company has declared the regular quarterly dividend of $1, payable June 29 to stock of record June 19.

Panama Power & Light Company has declared the regular quarterly dividend of 1¾ per cent, payable July 1 to stock of record June 22.

West Penn Power Company has declared the regular quarterly dividend of 1¾ per cent on preferred stock, payable August 1 to stock of record July 20.

Earnings.

UTAH POWER & LIGHT COMPANY.

(Including Western Colorado Power Company.)

	1918.	1917.
May gross	$ 443,413	$ 405,845
Net after taxes	233,003	213,303
Surplus after charges	240,751	222,702
12 months' gross	5,414,552	4,676,500
Net after taxes	2,791,426	2,441,316
Surplus after charges	2,888,780	2,526,624

KANSAS GAS & ELECTRIC COMPANY.

	1918.	1917.
May gross	$ 166,366	$ 134,985
Net after taxes	55,125	35,220
Surplus after charges	23,947	13,930
12 months' gross	1,829,742	1,691,369
Net after taxes	514,461	543,993
Surplus after charges	225,790	313,551

PACIFIC POWER & LIGHT COMPANY.

	1918.	1917.
May gross	$ 148,417	$ 127,055
Net after taxes	69,463	67,951
Surplus after charges	27,725	30,584
12 months' gross	1,747,461	1,522,404
Net after taxes	901,022	749,364
Surplus after charges	448,924	337,213

LAKE SHORE ELECTRIC COMPANY.

For April—		Increase.
Gross earnings	$162,982	$24,878
Operating and taxes	118,610	25,056
Net	44,372	*178
January 1 to April 30—		
Gross earnings	$610,640	$92,245
Operating and taxes	466,830	99,775
Net	143,809	*7,529

*Decrease.

THE DETROIT EDISON COMPANY.

(Including Sudsidiary Companies.)

	1918.	1917.
May gross	$1,030,408	$ 962,630
Net after taxes	231,942	280,154
Surplus after charges	127,040	196,028
5 months' gross	5,681,213	5,128,734
Net after taxes	1,599,233	1,737,626
Surplus after charges	1,100,935	1,313,824

WESTERN STATES COMPANY.

Net earnings of the Western States Gas & Electric Company for the month of May were 15.8 per cent greater than for the corresponding month last year. Net earnings for the year ended May 31 were 6.9 per cent greater than for the corresponding previous period. Comparative statement is as follows:

Month of May—	1918.	1917.
Gross earnings	$ 130,669	$ 110,311
Net earnings	56,236	48,558
Year ended May 31—		
Gross earnings	$1,494,523	$1,295,225
Net earnings	655,625	613,230

COLUMBIA GAS & ELECTRIC COMPANY.

For May—	1918.
Gross earnings	$ 877,375
Net operating earnings	422,214
Surplus	244,812
For 5 months ended May 31—	
Gross earnings	$5,314,281
Net operating earnings	2,676,687
Surplus	1,717,646

PHILADELPHIA RAPID TRANSIT COMPANY.

For May—	1918.	1917.
Gross earnings	$ 2,696,625	$ 2,570,440
Net earnings	964,392	1,133,581
Surplus	150,099	322,687
From July 1 to May 31—		
Gross earnings	$27,757,175	$26,027,815
Net earnings	10,892,325	11,428,704
Surplus	1,952,362	2,475,596

UTAH SECURITIES CORPORATION.

The properties now controlled by the Utah Securities Corporation, inter-company charges eliminated, report for May as follows:

	1918.
Gross earnings	$ 569,568
Net earnings	300,057
For the 12 months ended May 31—	
Gross earnings	$6,897,529
Net earnings	3,679,501

NEWFORT NEWS & HAMPTON RAILWAY, GAS & ELECTRIC COMPANY.

	1918.	1917.
April gross	$156,294	$92,872
Net after taxes	44,730	36,369
Surplus after charges	24,326	15,832

Philadelphia Company.

Philadelphia Company has issued its pamphlet report covering operations for the fiscal year ended March 31, 1918. The consolidated income account compares as follows:

	1918.	1917.	1916.	1915.
Gross earnings	$11,332,440	$9,210,148	$8,028,519	$7,288,753
Expenses and taxes	5,881,970	4,093,992	3,405,047	3,406,884
Net earnings	$ 5,450,470	$5,116,156	$4,623,473	$3,881,869
Other income	2,724,088	2,830,882	2,658,048	2,312,527
Total income	$ 8,174,558	$7,947,038	$7,281,520	$6,194,395
Interest and other charges	4,034,442	3,555,287	3,424,137	3,357,828
Net income	*$ 4,140,116	$4,391,751	$3,857,383	$2,836,567
Preferred dividends	477,518	476,644	471,966	471,941
Common dividends	2,898,427	3,005,772	2,363,364	2,049,507
Surplus	$ 764,171	$ 909,335	$1,022,053	$ 315,119

*After dividends on the preferred stock, net income available for the 858,860 shares of common stock ($50 par value) was equal to $4.26 a share, as compared with $4.56 a share in the preceding year.

Cities Service Company.

	12 months ending May 31, 1918.	12 months ending May 31, 1917.	Month of May, 1918.	Month of May, 1917.
Gross earnings	$20,487,577.35	$15,218,272.65	$1,925,285.93	$1,565,425.54
Expenses	390,022.68	287,038.12	38,361.85	28,340.63
Net earnings	$20,097,554.67	$14,931,234.53	$1,886,924.08	$1,537,084.91
Interest on notes and debentures	8,297.46	42,624.37	5,897.17	234.52
Net to stock	$20,089,257.21	$14,888,610.16	$1,881,026.91	$1,536,850.39
Dividends preferred stock	3,916,314.50	3,038,169.65	336,123.00	299,124.50
Net to common stock and reserves	$16,172,942.71	$11,850,440.51	$1,544,903.91	$1,237,725.89
Debenture fund				$ 380,667.35
Contingent fund				845,216.19
Stock surplus				3,716,416.25
Surplus reserve				4,338,593.75
Surplus				20,643,285.99
Total surplus and reserves				$29,924,179.53
Number of times preferred dividend was earned				5.13 4.90
Per cent earned on average amount of common stock outstanding				60.90 54.48
Preferred stock outstanding				$69,960,500.36
In hands of public			$67,293,832.38	
Owned by company			2,666,667.98	
Common stock outstanding				$32,122,464.00
In hands of public			$26,647,135.45	
Owned by company			5,475,328.55	

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid June18.	Bid June25.
Adirondack Electric Power of Glens Falls, common	6	12½	15
Adirondack Electric Power of Glens Falls, preferred	6	70	71½
American Gas & Electric of New York, common	10+extra	88	88
American Gas & Electric of New York, preferred	6	40	40
American Light & Traction of New York, common	..	184	185
American Light & Traction of New York, preferred	6	94	94
American Power & Light of New York, common	4	40	39
American Power & Light of New York, preferred	6	68	66
American Public Utilities of Grand Rapids, common	..	..	..
American Public Utilities of Grand Rapids, preferred	6	..	..
American Telephone & Telegraph of New York	..	98½	95
American Water Works & Elec. of New York, common	..	4½	4½
American Water Works & Elec. of New York, particip	7	12½	12
American Water Works & Elec. of New York, first preferred	..	56	56
Appalachian Power, common	..	..	3
Appalachian Power, preferred	7	..	24
Cities Service of New York, common	+extra	210	210
Cities Service of New York, preferred	6	74½	74½
Commonwealth Edison of Chicago	8	100	100
Comm. Power, Railway & Light of Jackson, common	..	18	20
Comm. Power, Railway & Light of Jackson, preferred	6	44	44
Federal Light & Traction of New York, common	..	6	7
Federal Light & Traction of New York, preferred	..	29½	35
Illinois Northern Utilities of Dixon	6	..	..
Middle West Utilities of Chicago, common	2+extra	15	10
Middle West Utilities of Chicago, preferred	6	..	..
Northern States Power of Chicago, common	..	44	40
Northern States Power of Chicago, preferred	ex.div.7	84	82
Pacific Gas & Electric of San Francisco, common	..	33	33
Pacific Gas & Electric of San Francisco, preferred	6	79	79
Public Service of Northern Illinois, Chicago, common	7	71¾	71¾
Public Service of Northern Illinois, Chicago, preferred	6	84	82
Republic Railway & Light of Youngstown, common	4	19	18½
Republic Railway & Light of Youngstown, preferred	6	59	58
Standard Gas & Electric of Chicago, common	..	4	4
Standard Gas & Electric of Chicago, preferred	6	24	22
Tennessee Railway, Light & Power of Chattanooga, common	..	3	3
Tennessee Railway, Light & Power of Chattanooga, preferred	6	13	12
United Light & Railways of Grand Rapids, common	4	29	29
United Light & Railways of Grand Rapids, preferred	6	61	61
Western Power of San Francisco, common	..	12	11
Western Power of San Francisco, preferred	6	48	48
Western Union Telegraph of New York	extra	91	90⅛
Industrials—			
Electric Storage of Philadelphia, common	4	50½	51⅛
General Electric of Schenectady	8	143	149½
Westinghouse Electric & Mfg. of Pittsburgh, common	+extra	43	44½
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	64	64

*Last sale.

HOWARD EHRLICH,
Managing Editor.

FRANK A. MERKEL,
Advertising Manager.

SUBSCRIPTION — United States, $5.00; Canada, $6.00; Foreign, $7.50

Entered as second-class matter Nov. 7, 1908, at the P. O. at Chicago, Ill., under act of Congress of March 3, 1879.

Electrical Review

The Oldest Electrical Weekly in America.

Member of Society for Electrical Development, Inc.

Member Audit Bureau of Circulations.

International Trade Press, Incorporated

PUBLISHER

ELECTRICAL REVIEW,

ENGINEERING AND CEMENT WORLD,

THE ROAD-MAKER,

ELECTRICAL BLUE BOOK,

DIRECTORY CEMENT, GYPSUM, LIME MANUFACTURERS.

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42 Old Broad St., E. C.

Member of the Associated Business Papers, Inc.

Vol. 72 CHICAGO, SATURDAY, JUNE 29, 1918 No. 26

CONTENTS

Electrically Operated Quarry and Rock-Crushing Plant in Chicago 1067

Features of Artesian Limestone Company's Property—Electric Power Applied for Drills, Haulage, Crushers and Screens.

Better Lighting of Textile Mills.—By F. H. Bernhard 1070

Improved Lighting Aids Present Speeding Up and Prepares for After-War Demands—Intensified Production and Other Advantages—Common Defects—Mill Lighting Requirements.

Coal Conservation in Fact.—By C. R. Knowles 1078

Coal in Gaseous and Pulverized Form Must Eventually Replace Lump Coal for True Conservation—Federal and State Authority Advocated.

Abstracts of Papers Presented at Institute Meeting 1080

Summary of Engineering and Technical Papers at Annual Convention at Atlantic City, N. J., June 26-28.

Editorial Comment:
The Fuel Administration's Orders 1084
The Movement to Curtail Residence Lighting 1084
American Institute of Electrical Engineers' Convention 1085

Week's Events:
American Institute Meets at Atlantic City 1086
Electrical Manufacturing Industry Responding to Nation's Need 1089
New York Jovians Have Outing at Brighton Beach 1090
War Problems Discussed by Southeastern Section, N. E. L. A. 1090
Massachusetts Electrical Contractors Protest Against Government Practice in Electrical Construction 1091
National Electrical Contractors and Dealers Will Meet in Cleveland 1091

Commercial Practice.
Line Extensions Under War Conditions 1092
Seattle Company Sells Bonds to Complete War Construction Work 1092
Government Use of Electric Trucks 1093
Mobile Electric Kitchen Meets with Favor in Halifax 1093
Public Utility Commission Has Power to Establish Electric Rates 1094
Hauling Ice Electrically 1094
A Public Electric Kitchen in London 1094
Electric Rate Increases Granted. 1094

Contracting-Construction:
Bending Racks and Roll Benders for Large Conduit and Pipe. By Terrell Croft 1095
Suggestions on Care of Resistance Units.—By A. Gemmell. 1096
Wrenches for Conduit.—By C. W. Connette 1097
Work Supports Made from Discarded Material.—By Charles H. Willey 1097

New Appliances 1093
Current Electrical News 1100
Trade Activities 1103
Recent Electrical Patents 1104
Men in Service 1105
Personal 1106
Financial News 1107

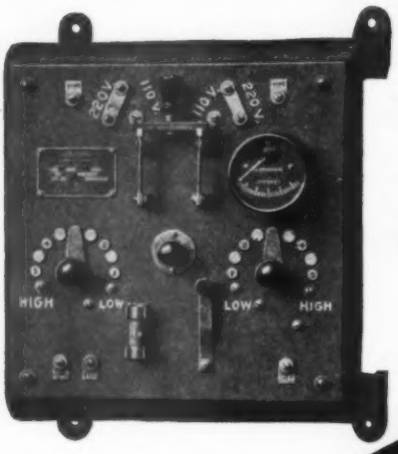
Classified Index ..... 46 **Alphabetical Index** 56

Westinghouse

Cooper-Hewitt Rectifier Outfits

Type E and Type WI

make the charging of automobile ignition and lighting batteries easy and profitable.



Large Capacity Type E, 5 and 10-Amp. Outfit with Ammeter (extra) for use in Garages that may have a number of batteries to charge at one time. Two capacities, 1 to 18 and 1 to 36 lead cells. Size 19" high, 14⅜" wide, 14½" deep.

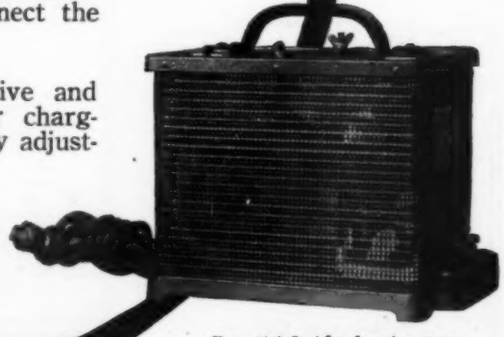
Small Type E, 10-Amp. Outfit with Meters (Extra) for charging 3 to 10 lead cells. One to 5-cell lead batteries can be charged at once in series. Size 19" high, 14⅜" wide, 14½" deep.

There is a large waste when charging low-voltage batteries with rheostats.

Westinghouse Cooper-Hewitt Rectifier Outfits charge one cell or many cells in series without waste. This flexibility adapts them to the varying conditions met with in any charging station. They are the only types of battery charging apparatus having this flexibility.

All that is necessary to operate the Type E outfit is to connect the batteries in series to the proper binding posts, set the dials for the number of cells being charged, and turn the starting handle. No further attention is required except to disconnect the batteries as they become charged.

Type WI is a simple, inexpensive and practically fool-proof outfit for charging 6 cells, or less, without any adjustment whatever. It can be placed on a table or shelf and connected to any lamp socket, by means of the cord and attachment plug furnished.



Type WI Outfit for charging 6 cells or less. Space required 10" by 6¼" by 8⅛" high.

W
WESTINGHOUSE ELECTRIC

Westinghouse Electric & Manufacturing Co.

East Pittsburgh, Pa.

Atlanta, Ga.	Charlotte, N. C.	Denver, Colo.	Joplin, Mo.	New Orleans, La.	Salt Lake City, Utah
Baltimore, Md.	Chattanooga, Tenn.	Des Moines, Ia.	Kansas City, Mo.	New York, N. Y.	San Francisco, Cal.
Birmingham, Ala.	Chicago, Ill.	Detroit, Mich.	Louisville, Ky.	Philadelphia, Pa.	Seattle, Wash.
Bluefield, W. Va.	Cincinnati, Ohio	Duluth, Minn.	Los Angeles, Cal.	Pittsburgh, Pa.	Syracuse, N. Y.
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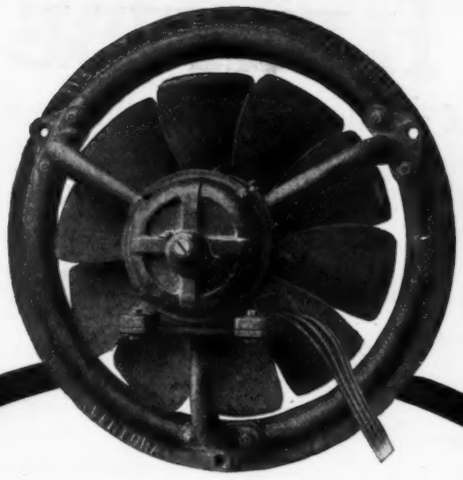
Charleston, W. Va.	Dayton, Ohio				

A War Necessity

Westinghouse Ventura Electric Fans-



For the Store, Office, Shop, etc.

Thousands of Women Are Filling Men's Places!

Are you looking after their comfort?

Remember, they are doing men's work in men's places.

These women soldiers of the Nation's workshop, not only *deserve,* but *require* greater comforts than men.

Westinghouse Ventura electric fans will lighten their labor, and increase their efficiency during the hot summer months.

It is your duty, Mr. Dealer, to prepare to meet the increased demand this season for ventilating equipment. Westinghouse-Ventura electric fans are built in many sizes for all domestic and commercial uses. Like all other Westinghouse Products, they have a national reputation for efficiency and reliability. This makes them ready sellers.

Westinghouse Electric & Manufacturing Company

Sales Offices in All Large American Cities

East Pittsburgh, Pennsylvania

W WESTINGHOUSE ELECTRIC

108

Westinghouse

FLEXTUBE

The only parts of a coil you have to throw away are the identifying red, white and blue tie ribbons. FLEXTUBE samples and descriptive Bulletin No. 151 sent on request.

National Metal Molding Co.

Manufacturers

Electrical Conduits and Fittings

1106 Fulton Building, Pittsburgh, Pa.

Atlanta, Boston, Buffalo, Chicago, Dallas, Denver, Detroit, Los Angeles, New York, Philadelphia, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, Buenos Aires, Havana, Manila, Paris

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED—CANADIAN DISTRIBUTORS

Double Compounding Double Value

F9

TRADE DAUM MARK

65-1000 A. 250-600 V.

The Simplest Fuse Made

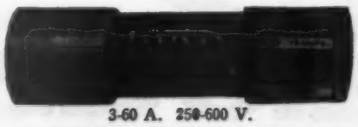
The Original

Daum Refillable Fuses for electric light and power are the simplest fuses made and have been adopted as standard by the largest users of fuses in the world. Study the cuts and send for bulletins.

A. F. DAUM

1157 Hodgkiss Street, Pittsburgh

Representatives: Squire & Cogswell Co., Ellsworth Bldg., Chicago. Geo. H. Trask, San Francisco, Cal.



3-60 A. 250-600 V.

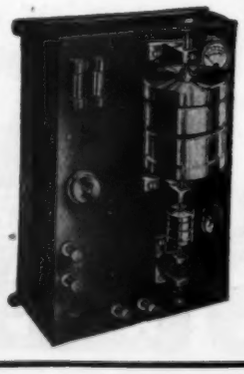
THE BRECO CONVERTER FOR

Charging batteries or for any other purpose where it is necessary to change A. C. to D. C. *is far superior.*

HIGHLY EFFICIENT, ECONOMICAL, RUGGED AND VERY EASY TO OPERATE

The new, modern method, tested by years of every day service, endorsed by the highest authorities.

Price $24.00 up. Sizes—1 Battery up.



Battery charging becomes a very simple, inexpensive and mighty profitable matter with the Breco Charger.

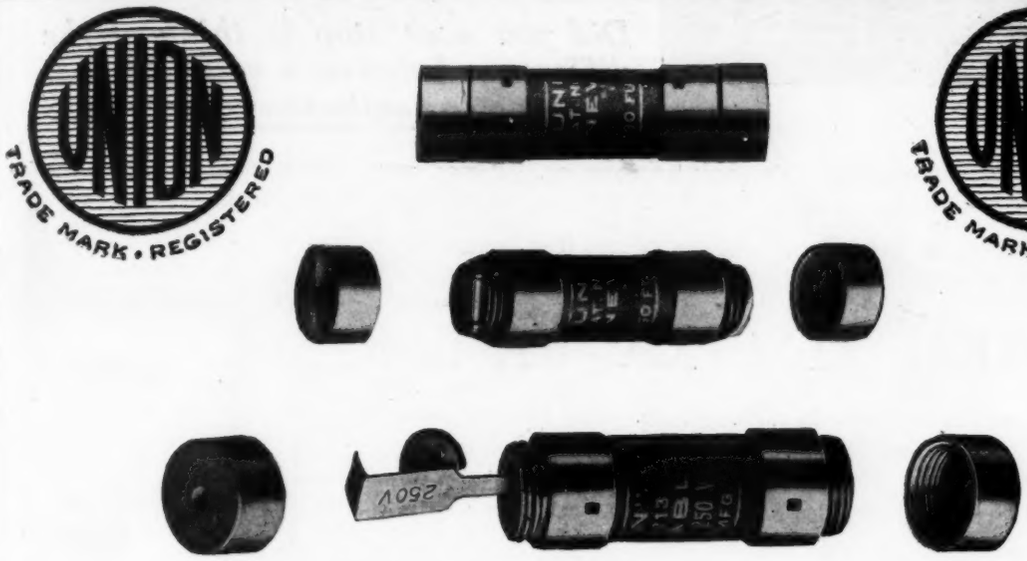
Write for Catalog No. 25

THE

Breco Electric Co.

206 Huron Street, Toledo, O. U. S. A.

SOLE LICENCEES



Thirty years of knowing how

creates this definite and confident proposition:

Try "UNION" Fuses thirty days. If they do not fully bear out every claim we make for them, return them to your dealer. He is authorized to refund your money without argument.

This is a definite proposition with the element of chance removed. You are constantly seeking a *newer* and *better* fuse. The only way to find it is to *try them out.*

Competitive tests beat slick salesmanship. Every month a great many big industrial plants adopt "UNION" renewable fuses after competitive tests.

We are more than willing to send "UNION" Renewable Fuses into any competitive test you may devise. We want "UNION" fuses to do their own talking. They'll *prove* themselves if given the opportunity.

And this is what they will prove: Unexampled simplicity—highest efficiency—longest life—lowest cost—and less than 5 per cent average cost for renewal.

This means: After original purchase, 20 new fuses for the cost of one, by using our "quick renewal" links.

Is there anything more you can *ask?* Can anyone *offer* anything more? We think *not.*

"UNION" Fuses are sold by all dealers in electrical supplies

Chicago Fuse Mfg Co.

Manufacturers of **Chicago** *Renewable Fuses* **New York**

FEDERAL

Did you ever stop to think of the difference between a satisfied customer and an enthusiastic customer?

The *satisfied* customer merely refrains from kicking. Almost any of the established makes of washers will satisfy. The *enthusiastic* customer boosts for you to her friends.

This advertisement is a salesman whose mission it is to interest you in the line of electric washers that makes *enthusiastic* users, the—

FEDERAL ELECTRIC WASHER

Of course you want such lines. So put it up to us to prove that the Federal makes good this claim. Write us and let us tell you the whole story.

The same features that please the user make a Federal easy to sell. Many of these features other washers cannot duplicate. They form the basis for unlimited salesmanship.

Our interest in Federal Electric Washers does not cease when we sell you. We work with you to help you *sell* them. After helping you sell, we give you assistance in financing your installment accounts.

You should be as interested as we. Are you? Will you write for details today?

Over three thousand Federal Electric Washers have been sold in Chicago by the Appliance Department of the Commonwealth Edison Company. They advertise Federal Washers extensively. Are you interested in knowing why?

FEDERAL SIGN SYSTEM (ELECTRIC)
Dept. A 1
Lake and Desplaines Streets, Chicago Branches in All Large Cities

STANDARD HUBBELL PLUGS

No. 5406

Hubbell Receptacles are installed in most of the best buildings. Hubbell Plugs are *standard* equipment for fans, irons and other portable devices.

Hubbell Plugs and Receptacles belong together—work together—they have been the recognized *standard* of their class for years.

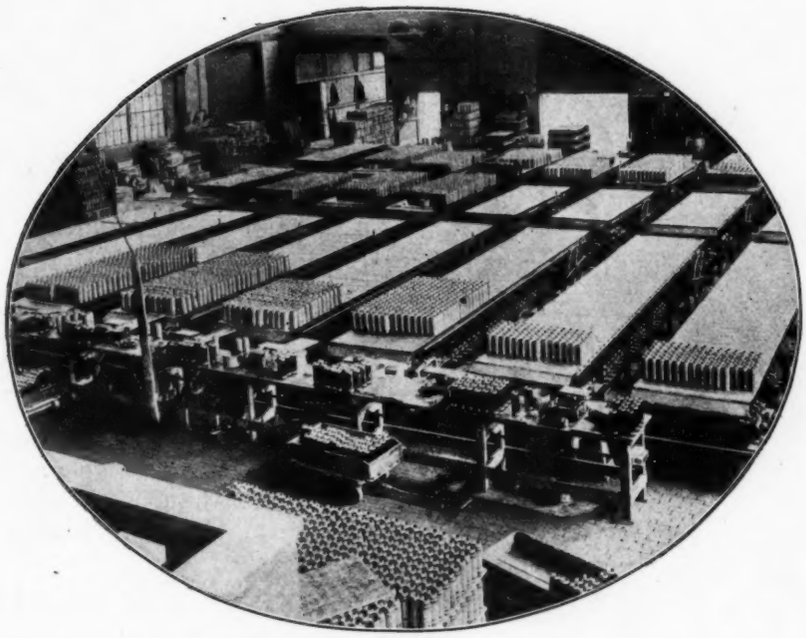
No. 5915

No. 6915

EQUIP your devices with Hubbell Plugs. Your customers know them and *want* them because they are *Standard.*

Hubbell Receptacles are made to take Hubbell Interchangeable Caps.

HARVEY HUBBELL, Inc.
BRIDGEPORT, CONNECTICUT



In plants where shrapnel is made—where high explosives are handled—where all possible precautions must be taken against fire hazards — electrical circuits are protected against overloads and short circuits by

ECONOMY renewable FUSES

There can be no mistaking that ***safety*** is the ***first*** consideration here. In addition to cutting annual fuse maintenance costs, Economy Fuses measure up to the standards of accuracy and uniformity demanded by such users as the principal steel and powder mills and the U. S. Navy. That is why there are millions in use by thousands of users representing all branches of industry.

An inexpensive little "Drop Out" RenewalLink restores a blown Economy Fuse to its original efficiency.

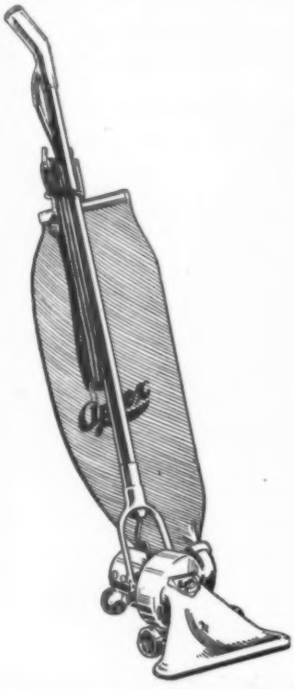
Write for Catalog 13

ECONOMY FUSE & MFG. CO.
Kinzie and Orleans Sts. CHICAGO, U. S. A.

Sole manufacturers of "ARKLESS" the Non-Renewable Fuse with the "100% Guaranteed Indicator"

ECONOMY FUSES ARE ALSO MADE IN CANADA AT MONTREAL

Price Advances July 15th—Buy Now,—Sell Later—'Clean-up' Additional Profits on



Apex

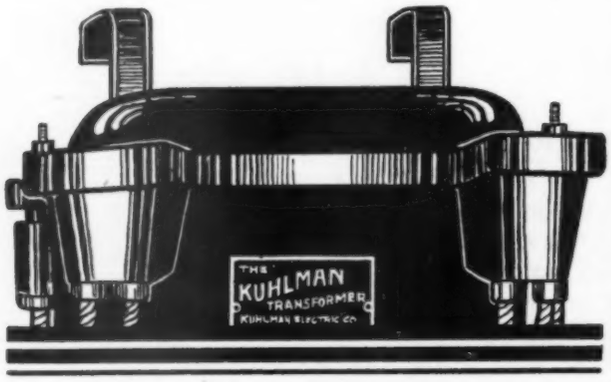
ELECTRIC SUCTION CLEANERS

Many dealers are now running our "Prior-to-price Increase" ads in their local papers. Electros and copy furnished FREE. Act quick and you too, can run a similar campaign.

Write Your Electrical Jobber AT ONCE

Your Jobber now has a more attractive proposition to make than ever before in the history of APEX. Bigger profits and better sales co-operation on the cleaner that has set the pace for efficiency, lightness and durability. Don't let this opportunity slip!

The Apex Electrical Distributing Co.
1111 Power Avenue, Cleveland, Ohio



KUHLMAN
TRANSFORMERS

are built for continuity of service. The liberal factors of safety employed in their design reduce the amount of attention required, thus eliminating costly interruptions of service. Copper and core losses are extremely low, and maintenance costs are astonishingly small.

It will pay you to investigate—NOW

KUHLMAN ELECTRIC COMPANY
Bay City Michigan

OshKosh Tools

YOU cannot afford to *experiment* with construction tools. You want tools you can depend on, no matter what the demand—tools that have been tested and proved.

You know how important it is to have men satisfied—to give them tools they like to work with—tools that are handy, and *fit the job.*

So you will want Oshkosh Construction Tools on your jobs, because they are standard. They *fit your needs*—they represent the best in both materials and workmanship—and they are backed by the Oshkosh reputation for quality products.

Your jobber carries Oshkosh Tools.

OSHKOSH MFG CO.
316 Review Street, Oshkosh, Wis.

INDUSTRIAL LIGHTING not only offers a splendid opportunity for new business on the part of every branch of the electrical industry but it constitutes a patriotic necessity in these times of forced production and 24 hour operation.

The following manufacturers of lamps and reflectors are co-operating in the movement for better lighting. Their announcements are of especial importance. : : : : : : :

Make a Survey

There's a lot to be done in the lighting of factories the country over. War time needs have forced production to the limit. A big percentage of it this year will be done under artificial lighting. After-dark work will be carried right through the summer.

Here is your opportunity to help the manufacturers in your locality. Show them how better lighting with National MAZDA lamps will enable the night shift to turn out work at daylight efficiency.

But to start with, size up the possibilities thoroughly. Make a personal canvas. Pick out the poorly lighted plants, getting the name of the man whose job or interest lies in keeping production at top notch speed. With such a list you will know just where to bunch your hits.

Say the word and we will submit suggested sales letters that will pave the way to factory lighting lamp sales. Write to the Sales Division furnishing you lamps.

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK, CLEVELAND
Member Society for Electrical Development—"Do It Electrically"

IVANHOE
STEEL REFLECTORS

Fight Glare! No Compromise!

Asking how much Glare is "allowable" in a factory-lighting installation is like asking how much poison is permissible in your food.

There is no line you can draw! There is no point at which you can say, "This much is safe—more would be dangerous.

Any compromise with a ruthless enemy is a defeat! Any compromise with Glare means that the factory doors have been deliberately opened to a dangerous destructive force.

Do not tolerate Glare—***even in a modified degree!*** Install the IVANHOE Reflecto-Cap Diffuser. At a "practical" cost, it is a most potent defense against Glare! It is not too expensive, either to install or to operate, in any plant where top speed and conservation of eyesight are worth ***anything.***

Give this unit a genuine try-out. Suggest a trial in an entire bay or building. With the results of such a test before your customer, he will have ***no temptation*** to return to former working conditions.

IVANHOE-REGENT WORKS
of General Electric Company
Cleveland, Ohio
"Ivanhoe" Steel Reflectors and "Regent" Illuminating Glassware

NOTE—We have taken over the exclusive sales rights of the Ander-on Self-Adjusting Lamp-Arm (for local lighting) which has the patented shoulder, elbow and wrist-joints. With one straight motion you carry the light from wherever it is to wherever you want it, and there it stays without adjustment.

REGENT Glassware

The lighting of offices, stores and homes may be beautiful as well as efficient. Regent Glassware is ***both*** in unusual degree.

Service to Lamps

Efficient Industrial Lighting

always obtained with

ABOLITES

Holder Socket, Dome Type Abolite.

Holder Socket, Diagonal Type Abolite.

Holder Socket, Deep Bowl Type Abolite.

Old and new factories, freight yards, docks, ship yards, etc., all require uniform and efficient electric lighting. Each aims to increase production and keep down cost.

The use of Abolites is the logical result. These porcelain enameled steel reflectors make good from every angle with users, engineers and architects, contractors and jobbers.

The **Abolite** line is complete for every lighting need and of A-B make throughout. Uniformly porcelain-enameled in our own plant.

Abolites consistently give uniform illumination combined with lowest maintenance cost for both lamp and reflector. Their merit proved in thousands of installations, specify Abolites the next time and they will make good to you.

The Adams-Bagnall Electric Co.

CLEVELAND, OHIO

Manufacturers of Electrical Apparatus with Engineering Merit { **Industrial, Commercial and Street Lighting Equipment; Distributing, Power and Constant-Current Transformers; Gyrofans; Oscillating Fans; Auto Electrical Accessories.**

Write now for data or quotation on your requirements in any of these lines

View in Holeproof Hosiery Company, Milwaukee, taken at night under Alexalite Illumination

ALEXALITE ILLUMINATION
for
KNITTING & TEXTILE MILLS

This illustration of correct lighting speaks for itself. Note the absence of shadows and the general uniformity of the light distribution. Due to perfect diffusion the operator can focus her attention on the work without the distracting glare from the polished needles.

Alexalites in themselves are unobtrusive. They cause no "squints." Their lighting is noticeable principally through the objects illuminated.

ENGINEERING SERVICE

You can secure complete data or try out Alexalite Illumination in your factory through our Engineering Service.

In this department we maintain Illuminating Engineers, experienced and expert in solving problems of industrial lighting. The benefit of their experience and advice is yours without cost should you desire it. They have solved the problems of many of the largest manufacturing plants in the country. Why not yours? ***Write Illuminating Department.***

Central Electric Co.

The House of Service

OKONITE TRADE MARK REG U.S. PAT. OFFICE

316-326 So. Wells St. CHICAGO

OKONITE TRADE MARK REG U.S. PAT. OFFICE

BENJAMIN

Proved Efficiency
In Textile Establishments

MANY essential industries, among them textile manufacturers, are making every hour of the twenty-four a working hour in these "speed-up" days. They are depending on Benjamin Lighting to make the night hours profitable.

Light controlled by Benjamin Reflectors is scientifically directed and diffused. It is properly placed with relation to the working plane. The reflectors are properly fitted with lamps according to the work and the need of the worker. There is no eye strain—therefore less accident, less spoilage and more production.

These are facts—proved by every installation. Why not profit by repeating the proof in *your* establishment?

Our valuable collection of literature on profitable industrial lighting is yours for the asking.

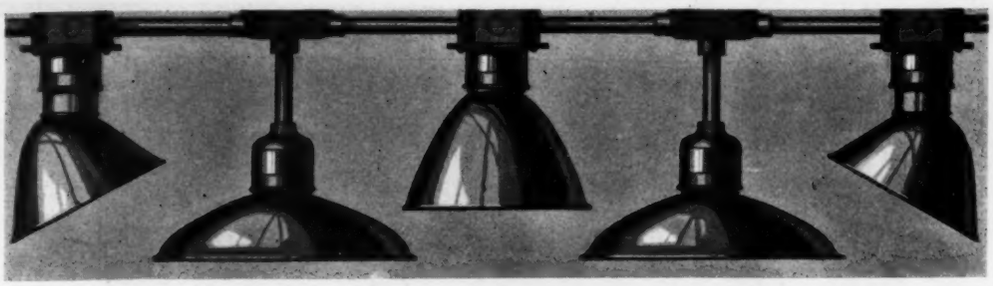
BENJAMIN ELECTRIC MFG. CO.
120-128 S. Sangamon St., Chicago

243-247 W. 17th St.
New York

590 Howard St.
San Francisco

BENJAMIN PRODUCTS

Profitable Lighting For All Industries



CUTTER HOLDER SOCKETS

SOL-LUX LIGHTING REFLECTORS

A CONSERVATION COMBINATION

Textile mills the country over are humming with war-time activity. The women straining their eyes watching the intricate machinery must have adequate, properly diffused light. It means the minimizing of "seconds," spoliage, and shut downs.

CUTTER HOLDER SOCKETS

make possible the changing of reflectors and lamps to obtain proper distribution and intensity of light whenever and wherever needed. CUTTER HOLDER SOCKETS are easily installed by one man in a few minutes. They save 75 per cent of the cost of installing standard heel reflectors.

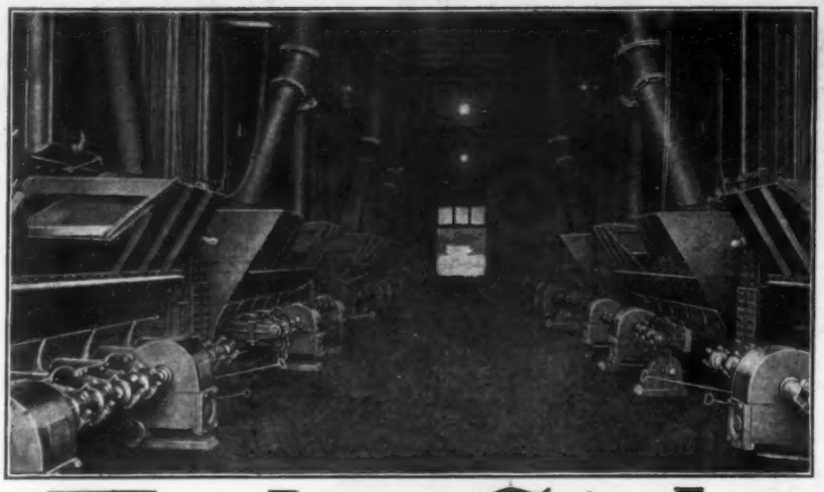
SOL-LUX Lighting Reflectors

eliminate the glare of high powered lamps and add to their efficiency. They distribute the light properly upon the work. CUTTER HOLDER SOCKETS facilitate cleaning of reflectors, thus effecting a considerable increase in lighting efficiency. CUTTER HOLDER SOCKETS and SOL-LUX Lighting Reflectors offer combinations that mean maximum efficiency in industrial lighting at a minimum expenditure of time, labor and money. Investigate at once.

GEORGE CUTTER COMPANY

411 Notre Dame St., SOUTH BEND, IND.

Chicago Detroit New York
Los Angeles San Francisco Seattle



The Taylor Stoker

NATIONAL SERVICE★★★ and the FUEL SITUATION★★

The winter of 1917-1918 will be memorable as marking a national appreciation of the priceless value of coal. Our industries and the health and comfort of the people depend directly upon the available store of coal.

Unprecedented demand and the failure of the railroads to furnish adequate transportation facilities created a serious condition. What the future will be is problematical, but it is certain it will be a long time, if ever, before coal is cheap again.

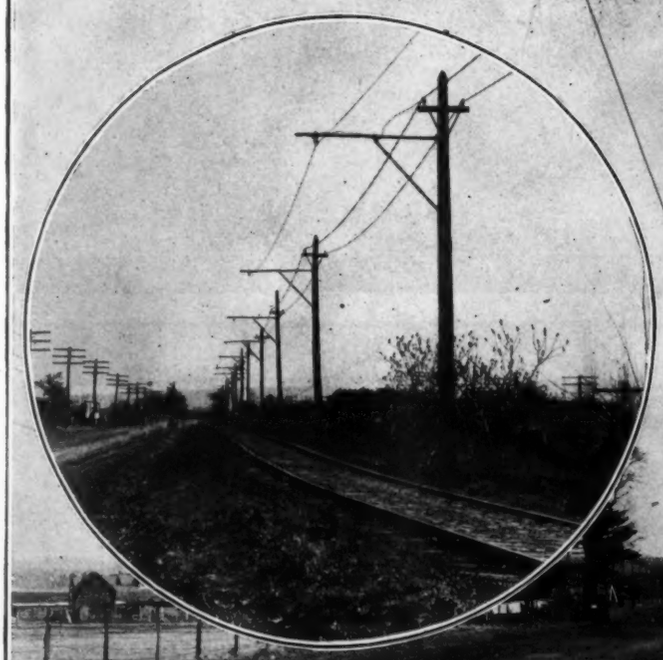
If you would reduce your coal bill by using inferior grades of coal; reduce freight charges by shortening the haul; almost eliminate upkeep while reducing labor costs and increase capacity—the use of TAYLOR STOKERS in your plant becomes imperative.

TAYLOR STOKERS burn any coal that will burn—culm, slack, run-of-mine—once looked upon as worthless, are now valued fuels. Thus, TAYLOR STOKERS are doing an individual and national service. The TAYLOR conserves higher grades of coal for other uses; it aids in relieving the problem of transportation and enables plants to run on what was once considered waste fuel.

The TAYLOR STOKER is the NATIONAL STOKER.
Come to us now with your problems on fuel, on smoke abatement and on increased production.

American Engineering Company
Philadelphia

Northern White Cedar Poles



Lines of the Burlington Traction Company, Burlington, Vermont,—Interurban Line. Photo recently taken between Winooski and Essex Junction.

The data on this pole line says that these poles have been in service **over 20 years** and are still in good condition.

There are many **Northern White Cedar Pole** Lines in different sections of the country in service from 15 to 20 years which prove conclusively the **Long Life** of **Northern White Cedar Poles.**

Northern White Cedar Association

Lumber Exchange **Minneapolis, Minn.**

LUMA Radium Luminous Compound

For Push Switch Buttons, Pull Chains, Dials, etc.

There is a growing demand for push switch buttons, pull chains, dials and various electrical specialties that are **visible in the dark.**

Have you, Mr. Manufacturer, considered the possibilities of such a line?

Luma is the one best luminous compound. It contains genuine Radium, is highly luminous and of great permanency.

Write for literature and full information.

RADIUM CHEMICAL CO.

POWERS BLDG. 3RD AVE. & 23RD ST. PITTSBURGH, PA.
ASTOR COURT BUILDING, NEW YORK, N.Y.

"XDUCT"

Galvanized Conduit

Made for users who want the best.

XDUCT is a high-grade conduit, designed and made with a view to meeting all the requirements essential to precise work in electrical wiring.

Made from easy bending, Spellerized Mild Steel Tube. Protected from rust by a heavy deposit of pure non-corrosive zinc. Enameled inside with especially prepared black enamel which forms a smooth glossy interior through which the wires are easily fished.

Furnished in 10-foot lengths, reamed and threaded on both ends with coupling on one end.

AMERICAN CIRCULAR LOOM CO. TRADE MARK NEW YORK

Write for samples

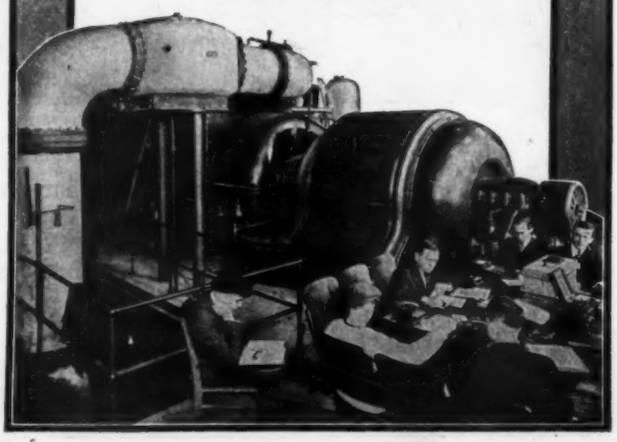
AMERICAN CIRCULAR LOOM CO.
90 West St., New York
Boston Chicago Los Angeles San Francisco Seattle Toronto

Operating Tests

are part of E. T. L. service used and appreciated by central stations and manufacturers in all parts of the country. Distance from New York is no bar to prompt service.

Send for Bulletin 12

Electrical Testing Laboratories,
80th St. and East End Ave.
NEW YORK CITY



THIS NOTE IS FOR YOU

Have you written us that letter about the lifting magnet that you need to replace some of the men taken in the draft?

We are in good shape to give you good delivery on all sizes.

When you write us, tell us just what you want to accomplish and we will tell you how to do it.

An E & M lifting Magnet will replace from 25 to 40 men.

The Electric Controller & Mfg Co.,
Cleveland Ohio.

Use VUL-COT FIBRE

a higher development of vulcanized cotton fibre

—for washers

VUL-COT FIBRE is particularly well suited for the making of insulating washers because it has high non-conductive powers, is hard and tough without being brittle and withstands severe service.

Vul-Cot Fibre can be machined to practically any required shape, from tiny washers for the most delicate electrical instruments to heavy, tapped washers for large motors. The thinner sizes can be stamped on high speed machines.

Although millions of Vul-Cot Fibre washers are used, this is but one of the many forms in which this adaptable material is applied. In every electrical plant there are many places where this serviceable material can be used economically.

Sold in sheets, rods and tubes. Special parts machined to your order.

Write for samples and full particulars.

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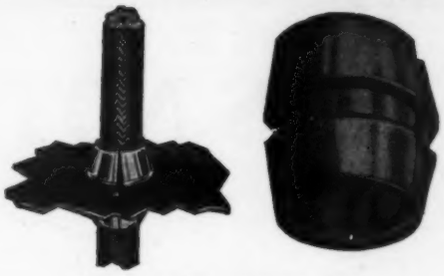

Many a Short Circuit is Avoided by the use of

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They can't pierce the walls of the flexible tubing or cause friction, as there are no sharp teeth. They firmly secure tubing to boxes and fittings without digging into or wearing the insulation.

Approved by Underwriters' Laboratories. Ordered by many local inspectors.

Samples Free

NEW PROCESS SPECIALTY CO. Milwaukee, Wis.

Flexible Tubing Clamps can't cut tubing. The "safety first" way of holding the loom in place at either straight electric or gas and electric outlets.

JUST TRY ONE!!

NEW PROCESS NOISELESS PINIONS cut from specially prepared rawhide are provided in sizes and types to suit practically every gear combination. Noiseless and permanently so, extraordinarily clean, of exceptional durability and reasonable in cost, they are certainly worth a trial in your plant. Their use by machine operators and machine builders everywhere is their best indorsement.

May we send you our booklet—Noiseless Gear Driving?

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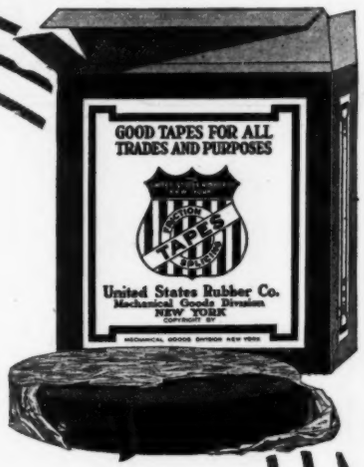
CANADIAN AGENTS: Robert Gardner & Sons, Ltd., Montreal, Canada 163



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Have you an all-round knowledge of the science of taping? Are you satisfied that the tape you are using is the best tape? Why not let our engineering department help you with your taping problems? If you are using any one of the

SIXTEEN SHIELD BRAND QUALITY TAPES

identified by the Shield and protected by the Seal of the world's largest rubber manufacturer, you are assured of tape, which is guaranted to stand the severest test for quality and absolute satisfaction.

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Alternating Current

The busy manufacturer cannot afford to install anything but absolutely

Dependable Motors

MOTIVE POWER is perhaps the most vital element in every plant. Without it, production ceases, and if your motors cannot be depended upon to deliver power when you want it and for as long as needed, night and day if necessary, you cour costly shut-downs.

No motor is better than it's weakest point. If it has a weak point it isn't a dependable motor and we urge all prospective purchasers to give serious consideration to this important fact.

In the *St. Louis Motor* we offer absolutely dependable motors—an achievement in motor design that nears perfection in motor building.

Single Phase, 10 sizes, from 1-8 to 2 h.p.
Polyphase, 10 sizes, from 1-2 to 10 h.p.

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PEERLESS MOTORS

¼ to 35 H. P.

Simple in Design
Sturdy in Construction
Satisfactory in Service

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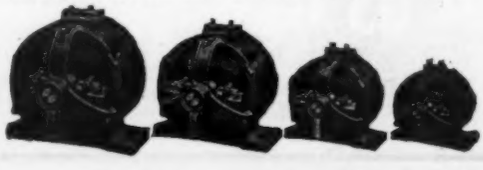
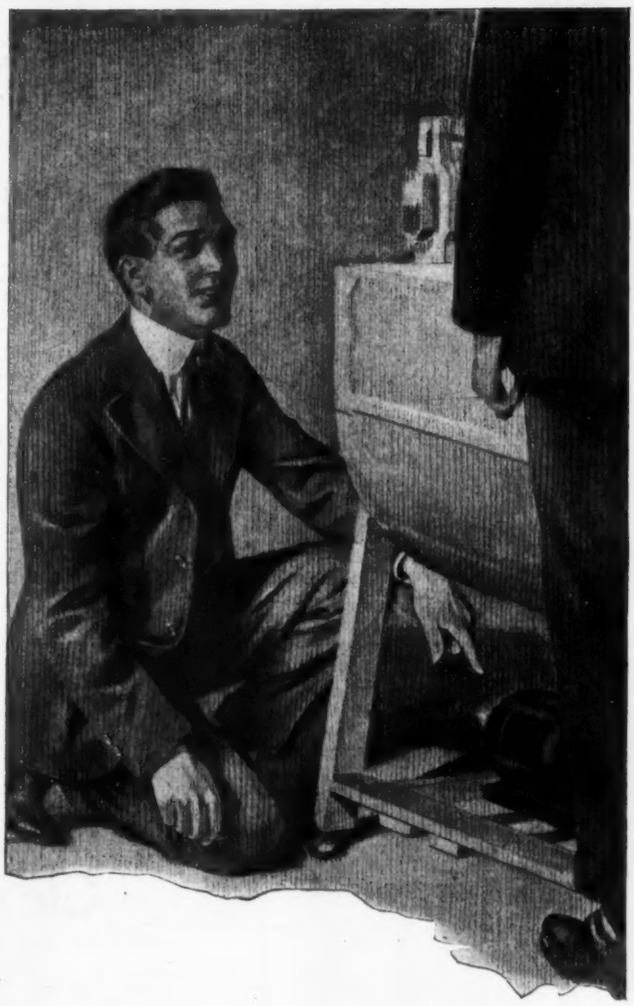
The F. BISSELL CO., Toledo, Ohio, Distributors.



A Live Tip For The Dealer From The Manufacturer's Salesman

When a manufacturer of washing machines, suction sweepers or electric-driven devices of any kind uses R & M Motors on his machines, his salesman always make use of this fact as one of their leading sales arguments.



And it is an argument which is always effective. Every dealer is familiar with R & M Motor quality and knows he can guarantee his customers reliable service from the R & M Motor equipped machine.

This same point which helps the manufacturer make his sales to the dealer is one which is also a big help to the dealer in making the resale.

For nearly ten years the R & M Motor has been advertised consistently in the leading magazines of general circulation. It is the one motor which has been so advertised. When the dealer mentions the R & M Motor on any machine he may be selling, he is speaking of the motor, the quality of which is known to nearly every man and woman who is a prospect for an electric-driven device.

Leading electric-driven devices of all kinds can be obtained with R & M Motor Drive.

THE ROBBINS & MYERS CO., SPRINGFIELD, OHIO

New York Philadelphia Boston Buffalo Cleveland Cincinnati Chicago St. Louis San Francisco

Robbins & Myers Motors

A telephone set up in an African jungle inhabited only by wild beasts would be of no value. The service which a telephone renders depends upon the active participation of the people whom it is designed to serve.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

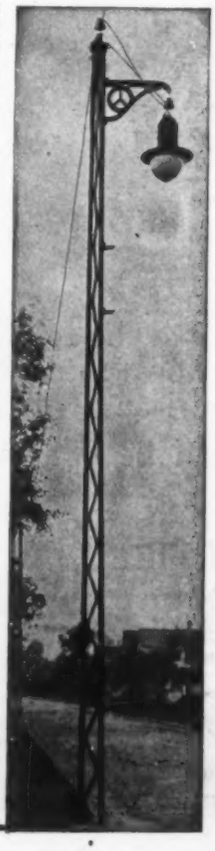
AMERICAN TELEPHONE & TELEGRAPH CO. LOCAL AND LONG DISTANCE TELEPHONE BELL SYSTEM AND ASSOCIATED COMPANIES

STEEL POLES For Every Pole Purpose

Cut shows Bates Steel Poles in street lighting service. 2,500 of these poles represent a big factor in Chicago's vast electric lighting system.

Bates Steel Poles are becoming universally popular world wide. Repeat orders testify their general suitability for every Pole purpose, Telegraph, Telephone, Power Transmission, Electric Trolley Lines, Electric Lighting, etc. Highest class and most up-to-date steel pole equipment in the world. Our STEEL POLE TREATISE tells the story. Ask for it.

About 2,000 tons of steel constantly on hand; immediate shipments and lowest prices.



Bates Expanded SteelTruss Company

208 So. La Salle St.
Chicago, Ill.
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International Clearing House

Anything to Sell?
Do you want help?
Do you require a position?

Make your wants (Electrical) known in the classified columns of the Electrical Review.

See pages 38 to 43 this issue

ALLIES

FUEL ADMINISTRATION

CENTRAL STATION

THE HUGHES ELECTRIC RANGE is the strongest agent of fuel and food conservation — and saves the day for the Central Station.

This is the day of electric cooking. Fifty million tons of coal must be saved in the United States in 1918. Electric cooking will do it!

202.5 tons of coal converted into electrical current will do the work of 800 tons burned in the home. Every public-spirited citizen will gladly have his kitchen equipped for electric cooking—especially when shown that it is so extremely economical that he will realize a saving on it the first year.

He will be shown this—through the nation-wide Hughes advertising campaign, which will be localized in your district when you say the word.

Government institutions are setting the example in switching to electric cooking. An army of landlords, home owners and housewives are falling in line.

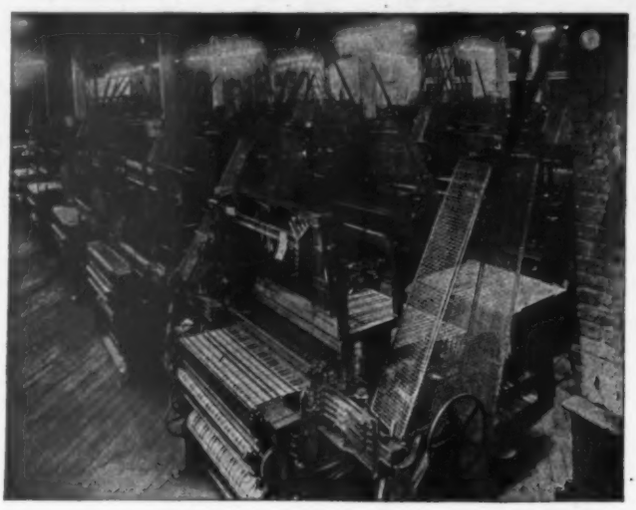
Help to mobilize those on your lines—and fatten the load that the extra daylight hour has made thin.

Write for agency proposition and complete plan of campaign

HUGHES

Edison Electric Appliance Co., Inc.

Chicago, Ill.



Who said Cooper Hewitt Light Couldn't Be Used for Handling Colors?

Whoever the individual was, he would change his opinion if he could see for himself the remarkable results obtained with pattern goods as indicated in the above photograph.

As President Wilson said of hard times, this color bogie is mostly "Psychological." When prejudice is laid aside, and Cooper Hewitt Light tried out squarely on its merits, and **used until the mind adjusts itself** to the difference in shades, it will generally be found, as it has so universally in the case of natural and solid colors, actually "Better than Daylight."

Never mind your "feelings" in the matter; **try it out under your own conditions.**

BETTER THAN DAYLIGHT

COOPER HEWITT LIGHT INCREASES PRODUCTION

Cooper Hewitt Electric Company

General Offices and Works, Eighth and Grand Streets, Hoboken, N. J.

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Electrical Review's

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for 1918

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- Complete tables of All-Night and Moonlight Schedules
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A PRACTICAL QUESTION AND ANSWER BOOK THAT COVERS A MULTITUDE OF POINTS CONCERNING TESTING, OPERATION, TROUBLES AND DEFECTS OF ELECTRICAL APPARATUS.

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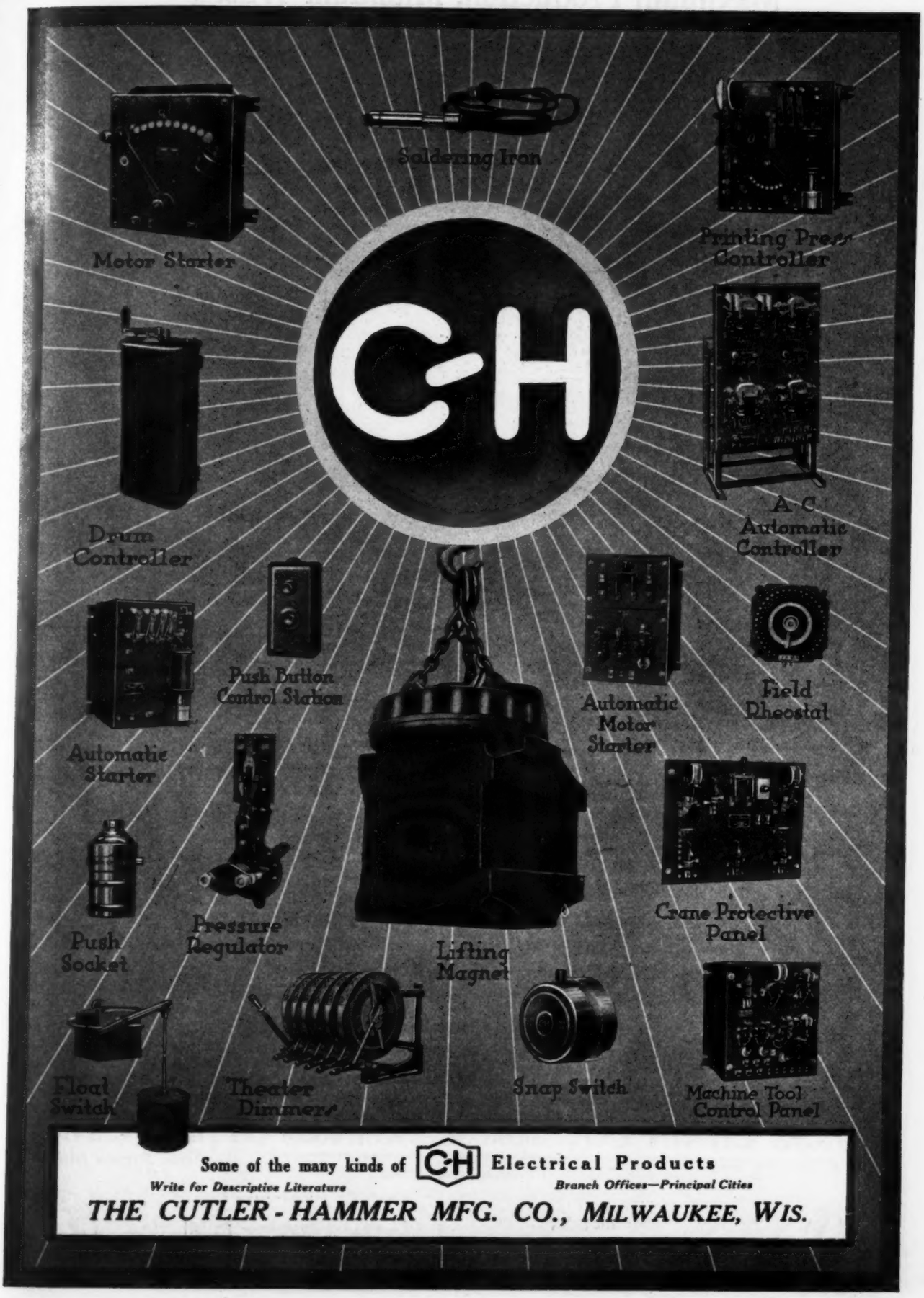
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Secure estimate on your Transmission loss, trace it to the source

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Our engineers, all specialists in the art of designing chain drives, are conveniently located in all the below cities, and wil gladly call at your request and assist in solving any power transmission problem without obligation.

We are always glad to furnish special information pertaining to our field and welcome inquiries, whether the writer is in the market for chain drives or not. Feel free to write us at any time.

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THAT MAKE IT EASY TO SELL

THE

Western Electric

NUMBER ONE IRON

Here are the first ten:

1. Balanced — prevents tiring of wrist or arm
2. Handle always cool Curved to fit hand
3. Rust-proof, highly polished nickel finish
4. Curved nose gets into corners
5. Ironing surface large—glides easily
6. Entire face of iron has perfect heat distribution
7. Black-and-white cord attractive—made to wear well
8. Beveled bushing eliminates cord breakage
9. Non-kink spring protects the cord
10. Large plug always stays cool

Here is the eleventh reason:

11. A bigger and better assortment of sales helps that will be supplied without charge—sales helps that will bring the iron business in your town to you—sales helps that consist of newspaper advertising plates, small folders in colors, lantern slides for the movies, window display outfits and display cards.

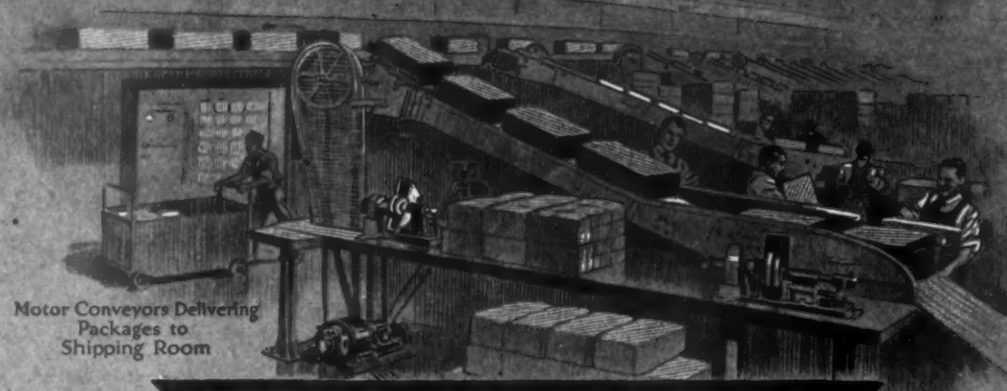
Warm weather is coming fast—the kind of weather when an electric iron makes a big hit—order your stock of irons and sales helps now.

Western Electric Company

INCORPORATED

OFFICES IN ALL PRINCIPAL CITIES

The Shipping Department Electrical



Motor Conveyors Delivering Packages to Shipping Room

The modern factory and store operate their shipping departments electrically. They have found that by motorizing their equipment they can ship more rapidly, more efficiently, more cheaply. In hundreds of stores and factories today, G-E Fractional horsepower motors transfer merchandise to the shipping room, wrap it, label it, weigh it and even compute its shipping cost.

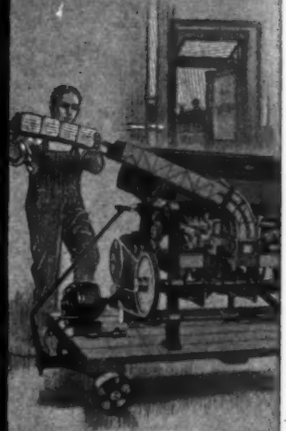
If your shipping department is not yet motorized it will pay you to investigate the many advantages of motor-driven equipment.

To Manufacturers of Shipping Department Equipment:–

This is the Motor Age. Progressive business men nowadays demand motor-driven equipment. If they are discriminating as well, they demand G-E motors. The sales value and prestige of your product will be enhanced immeasurably by the installation of G-E Fractional Horsepower Motors.

One of our 300 types of motors is doubtless adapted to your product. If not, we will make one to order. Enclose photograph or sketch of machine and address our nearest office.

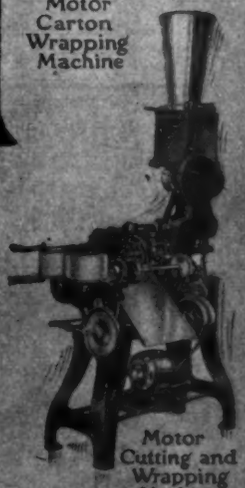
Motor Delivery Elevator



Motor Carton Wrapping Machine

Motor Adding Machine

Motor Labeling Machine



Motor Cutting and Wrapping Machine

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The Standard of Quality

THE great majority—

of American cities depend upon

Type H Power and Distribution Transformers

for reliable lighting facilities at night.

Hundreds of thousands of these transformers are in service, thousands more are on the way, and the reliability of the Type H continues as the greatest asset a Central Station can obtain.

Type H is the Standard of Quality in every sense of the word.

7355

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are unqualifiedly superior to any other instruments designed for the same service.

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23 Branch Offices in the Larger Cities

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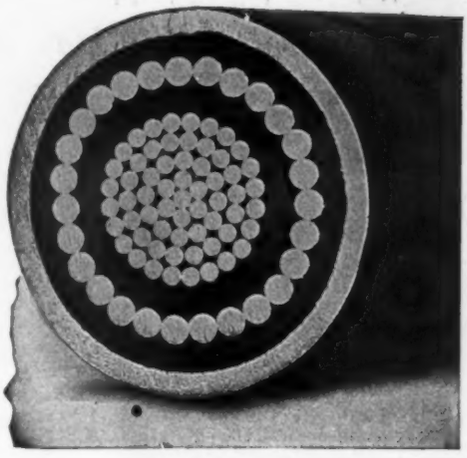

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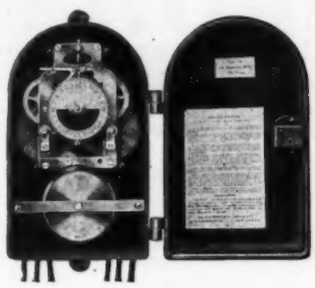

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3

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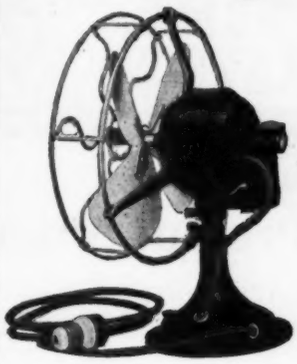

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We also manufacture 12 and 16 inch stationary and oscillating, 58 inch ceiling and 16 inch ventilating fans.

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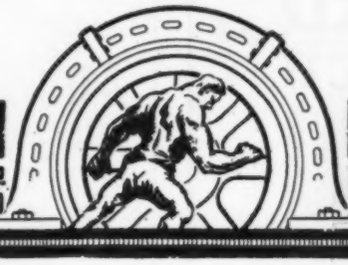

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TURBO-GENERATOR UNITS—60 Cycle

1—5000 KW. Gen. Elec.-Curtis horizontal turbo-unit, 3 phase, 2300-4000 volts, 3600 RPM., with Westinghouse-Le Blanc surface condenser and turbine driven pumps.
1—4000 KW. Westinghouse-Parsons horizontal turbo-unit, 3 phase, 2300 volts, 3600 RPM., with Westinghouse-LeBlanc surface condenser and turbine driven pumps.
1—1250 KW. Westinghouse-Parsons horizontal turbo-unit, 3 phase, 2300 volts, 3600 RPM., with LeBlanc jet type condenser and turbine driven pumps.
1—1000 KW. Gen. Elec.-Curtis vertical turbo-unit, 3 phase, 2300 volts, 1200 RPM., with Wheeler Cond. & Eng'g Co. surface condenser and necessary pumps.
1—750 KW. Gen. Elec.-Curtis horizontal mixed pressure turbo-unit, 3 phase, 2300 volts, 3600 RPM., with C. H. Wheeler surface condenser and necessary pumps.
1—600 KW. Westinghouse-Parsons turbo-unit, horizontal, non-condensing, 3 phase, 220 volts, 3600 RPM.
1—550 KW. Gen. Elec.-Curtis vertical non-condensing turbo-unit, 3 phase, 440 volts, 1800 RPM.
1—500 KW Gen. Elec.-Curtis, vertical, non-condensing turbo-unit, 3-phase, 4600 or 2300 volts, 1800 RPM.
1—550 KW. Gen. Elec.-Curtis vertical turbo-unit, 3 phase, 4000 or 2300 volts, 1800 RPM.
1—500 KW. Allis-Chalmers horizontal turbo-unit, 3 phase, 480 volts, 3600 RPM., with Allis-Chalmers jet condenser and necessary pumps.
1—500 KW. Gen. Elec.-Curtis horizontal turbo-unit, 3 phase, 2300 volts, 3600 RPM. NEW.
1—500 KW. Gen. Elec.-Curtis horizontal turbo-unit, 3 phase, 2300 volts, 3600 RPM., with Westinghouse-LeBlanc condenser and necessary pumps.
1—500 KW. Gen. Elec.-Curtis vertical turbo-unit, 3 phase, 4000-2300 volts, 1800 RPM., with Wheeler Cond. & Eng'g Co. jet condenser and necessary pumps.
2—400 KW. Westinghouse-Parsons horizontal turbo-unit, 3 phase, 2300 volts, 3600 RPM.
1—300 KW. Westinghouse-Parsons horizontal turbo-unit, 3 phase, 440 volts, 3600 RPM., with Wheeler Cond. & Eng'g Co. surface condenser and necessary pumps.
1—100 KW. Gen. Elec-Curtis horizontal turbo-unit, 2 or 3 phase, 240 volts, 3600 RPM.

ALTERNATING CURRENT DIRECT CONNECTED UNITS—60 Cycle

1—500 Kva. General Electric, ATB, 3 phase, 2300 volts, 120 RPM., dir. conn. to 27-in. x 42-in. Hamilton Corliss engine.
1—450 KW. General Electric, ATB, 3 phase, 2300 volts, 100 RPM., dir. conn. to 22-in. and 42-in. x 48-in. E. P. Allis cross compound heavy duty engine.
1—300 KW. General Electric, 3 phase, 2200 volts, 150 RPM., dir. conn. to 19-in. x 30-in. x 22-in. McEwen tandem compound eng.
2—340 Kva. Westinghouse, 3 or 2 phase, 220 volts, 150 RPM., Engine type. No Engines.
1—200 KW. Westinghouse, 3 or 2 phase, 220 volt, 116 RPM., dir. conn. to 20-in. x 42-in. Hewes & Phillips horiz., side crank eng.
1—120 KW. Allis-Chalmers-Bullock, 3 or 2 phase, 2400 volts, 277 RPM., engine type. No engine.
1—50 KW. Ft. Wayne, 3 or 2 phase, 60 cycle, 2300 volts, 300 RPM., dir. conn. to 11-in. x 12-in. Chuse horizontal engine.
1—50 Kva. Fairbanks-Morse, 3 phase, 2300 volts, type D, 300 RPM., Engine type. No Engine.

DIRECT CURRENT DIRECT CONNECTED UNITS—250-275 Volts

2—800 KW. Ft. Wayne, MPL., 250-275 volts, 16 pole, 120 RPM., dir. conn. to 26½-in. and 53-in. x 36-in. Erie City heavy duty cross compound engine.
2—500 KW. General Electric generators, MP-H, 275 volts, 10 pols, 100 RPM., each direct conn. to a 32-in. x 48-in. Greene engine.
2—500 KW. Fort Wayne generators, MPL., 220-250 volts, 10 pole, 90 RPM., each dir. conn. to a 22-in. and 38-in. x 48-in. Bates cross compound engine.
1—500 KW. Crocker-Wheeler, CCD, 250 volts, 16 pole, 90 RPM., dir. conn. to 22-in. and 38-in. x 48-in. Hamilton cross compound eng.
1—325 KW. Westinghouse, 250 volts, 10 poles, 100 RPM., dir. conn. to 16-in. and 30-in. x 42-in. Hamilton Corliss horizontal tandem engine.
1—200 KW. General Electric, MPC, 275 volt, 8 pole, 150 RPM., Engine type. No engine.
1—75 KW. Allis-Chalmers-Bullock, 250 volts, 6 pole, 275 RPM., dir. conn. to 11-in. and 18-in. x 11-in. Shepard vertical cross compound engine.
1—25 KW. Rochester generator, 230 volt, 6 pole, 400 RPM., dir. conn. to 10in. x 8 in. Buffalo Forge vertical engine.

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4—512 HP. Babcock & Wilcox, 200 lbs. pressure.
2—483 HP. Heine, 200 lbs. pressure.
2—480 HP. Stirling, 160 lbs. pressure.
1—400 HP. Babcock & Wilcox, 160 lbs. pressure.
4—360 HP. Erie City, 160 lbs. pressure.
14—290 HP. Babock & Wilcox, 160 lbs. pressure.
2—283 HP. Aultman & Taylor, 160 lbs. pressure.
2—283 HP. Babcock & Wilcox, 160 lbs. pressure.
3—243 HP. Heine, 160 lbs. pressurs.
2—240 HP. Stirling, 140 lbs. pressure.
1—310 HP. Stirling, 200 lbs. pressure.
3—156 HP. Heine, 160 lbs. pressure.

CATERPILLAR TRACTOR.

1—80 HP. Hornsby Steam Caterpillar Tractor with compound driving engine mounted directly on top of boiler. Tractor and tender approx. 20 ft. long overall, approx. extreme width over caterpillar chains 9 ft. length of caterpillar chains 17 ft. Complete with two heavily built 4-wheeled trailers and one trailing sled for winter use.

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Let us know your requirements, as we carry a large stock of various classes of electrical machinery other than the items mentioned below

TURBINES.

1—250 KW, 3600 rpm, 3-phase, 60-cycle, 440-volt Crocker-Wheeler NEW generator (NO TURBINE INCLUDED).

1—300 KW, 3600 rpm, 2-phase, 60-cycle, 2300-volt Westinghouse Parsons Turbine unit with Westinghouse LeBlanc Condenser driven by Westinghouse Turbine.

A. C. DIRECT CONNECTED UNIT.

1—50 KW, 300 rpm, 220 volt, 3-phase, 60-cycle, General Electric generator direct connected to a 11½x12 Ames engine with belted exciter.

D. C. DIRECT CONNECTED SETS.

500 VOLTS.

1—75 KW, 270 rpm, General Electric generator to an Ames engine.

1—150 KW, 200 rpm, General Electric to a 16x18 Harrisburg center crank engine.

250 VOLTS.

1—15 KW, 400 rpm, Sturtevant vertical set, 7x7.

1—30 KW, 300 rpm, NEW General Electric (generator only), type "LC."

1—30 KW Westinghouse to a 9x12 straight line engine.

1—30 KW Sprague, 300 rpm, to Harrisburg engine.

1—100 KW General Electric, form "L," shunt wound generator direct connected to a New York Safety Engine, 12x14-in.

1—100 KW, 250 rpm, General Electric, form "L" generator direct connected to a 14x15 Ames engine.

1—150 KW, 220 rpm, General Electric to a 16x18 center crank Harrisburg engine.

1—300 KW, 150 rpm, General Electric generator direct connected to a 20 and 34x28 Fitchburg 4-valve engine.

125 VOLTS.

1—15 KW General Electric Marine Set.

1—27 KW Bullock to a Haring engine.

MOTOR GENERATOR SETS.

1—17 KW, 250-volt, 1150 rpm, type "S" Westinghouse generator and a 25-H, 3-phase, 60-cycle, 1150 rpm type "BP" Wagner motor including coupling, rheostat and starter.

1—50 KW, 250-volt Siemens-Halske, complete with 2 General Electric 2200-volt air cooled transformers.

1—30 KW, 1200 rpm, 2300 volt, 2 or 3 phase, 60 cycle, type "ASB" General Electric alternator direct connected to a 45 HP, 250 volt, type "CL" General Electric generator, mounted on common base, 3 bearing.

1—40 KW, 500 volt generator to be mounted on bed plate, and one 60 HP, 220 volt, 2-phase, 25 cycle, 720 rpm, Westinghouse motor.

1—225 KW, 550 volt, 450 rpm, General Electric generator, direct connected to a 250 KW, 2 phase, 60 cycle, Westgh. motor.

2—250 KW, 550 volt, 450 rpm, Westgh. generator connected to 320 HP, 2200 volt, 2 or 3 phase, 60 cycle Stanley alternators.

1—250 KW, 550 volt, 450 rpm, Bullock generator direct connected to a 370 HP, 2200 volt, 3 phase Bullock alternator.

1—100 KW, 250-volt, 580 rpm, General Electric generator, excellent second hand condition and one 150-H, 3-phase, 60-cycle, 220-volt, 580 rpm slip ring type "M" General Electric motor, NEW, with coupling, rheostat and starting apparatus.

TRANSFORMERS.

SINGLE PHASE.

Qu.	Kw.	Make.	Cycles.	Type.	Voltage.
1	1	General Electric	60	H	1040x52/104
1	1	General Electric	60	H	127x110
1	1	General Electric	60	..	500x200
1	5	Pittsburgh	60	..	1500/3000x110
1	7½	General Electric	60	H	1040/2080x104/208
1	8	American	60	..	500x200
1	10	General Electric	60	H	1040/2080x52/104
5	10	General Electric	60	H	1040/2080x104/208
4	15	General Electric	60	H	1040/2080x104/208
1	20	General Electric	60	H	1040/2080x104/208
1	25	General Electric	60	HE	1040/2080x104/208
1	25	General Electric	60	H	1040/2080x104/208
2	100	Westinghouse (water-cooled).....	..	..	11000x2500
2	110	Westinghouse (water-cooled).....	..	OISC	2200x180/360
3	200	Westinghouse	29	OISC	22000x410
1	250	Westinghouse	60	OISC	13200x220/440
1	375	Westinghouse	60	OISC	2300x440

THREE PHASE.

6	5	Westinghouse	60	ST	2100/2200x220/440
4	5	General Electric	60	HT	2080Yx230/460
1	7½	General Electric	60	HT	2080Yx230/460
2	15	Westinghouse	60	ST	2100/2200x220/440
2	30	General Electric	60	HT	2080Yx230/460

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1—300 HP., 2200 volt, General Electric, 450 speed, 3 phase, 60 cycle Motor, complete with starting panel, consisting of starter and ammeter and oil switch. Delivery in two months.

2—100 KW. General Electric, 3 phase, 60 cycle, 2300 volt Generators, type ATB, form D, complete with switchboards.

1—13 KW., 275 volt, Fort Wayne, 1800 speed, type E. F. A., form I, 1 phase, 60 cycle Generator and Exciter.

1—200 KW., 3 phase, 60 cycle, 1100 volt, General Electric generator, type ATB, form D, speed 600.

1—450 KVA., 2300 volt, Allis-Chalmers, 200 speed, 3 phase, 60 cycle generator, 2 years old, good for direct connecting for engine drive or water wheel drive.

1—100 HP. new Westinghouse motor, 3 phase, 60 cycle, 550 volt, 900 speed.

1—50 KVA., 1150 volt, Crocker-Wheeler, 1200 speed, 2 phase, 60 cycle Generator and Direct Connected Exciter.

2—50 HP. General Electric, 220 volt, 900 speed, type I, form L.

30—2 HP. to 200 HP., 220 volt, General Electric, 3 phase, 25 cycle motors.

Motor Generator Sets

15 KW., 125 volt, C. & C., 550 speed, 8 pole Generator, direct connected to a Vertical Case Engine.

1—60 KW., 125 volt, Thompson & Ryan, 300 speed, Generator, direct connected to a 13x12 McEwen Engine and Switchboard.

Direct Current

2—100 HP., 110 volt, Holtzer-Cabot D. C. motors, 550 RPM., full commutators.

1—10 KW., 125 volt, Bullock, 400 speed, Marine set, direct connected on one sub-base to a Westinghouse vertical engine.

1—50 KW., 125 volt, General Electric, 280 speed, type Mp, Generator, direct connected to an 11x12 vertical Marine type engine.

1—300 KW., 500 volt, D. C. General Electric generator, 400 RPM.

1—56¼ KW., 125 volt, Westinghouse, 800 speed, type M, generator, complete, and in A1 condition.

1—80 KW., 125 volt, Crocker-Wheeler, 750 speed, type CCD Generator.

1—90 KW., 110 volt, General Electric, 690 speed, type CL, 6 pole, form B, generator.

1—500 KW., 550 volt, General Electric, 375 speed, type MP generator.

Boilers

2—300 HP. Holyoke Manning Boilers, now located in Massachusetts, good for 150 lbs., 11 years old, in splendid condition.

5—150 HP. Manning Boilers, now located in New Hampshire, good for 135-140 lbs., for delivery in about 2 months.

6—90"x18' 6" horizontal return tubular Dillon Boilers, now located in Rhode Island; installed in 1905.

1—250 HP. Sterling Water Tube Boiler, Mass. Standard, built in 1911. 160 lbs. pressure.

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1—9375 KVA., 2300 V., 60 Cy., 3 Ph., Westge. turbo., with cond.
3—1000 KW., 600 V., 3 Ph., Allis turbo units, with cond.
1—1500-3000 KW., 2400-4800 V., 60 Cy., 2 Ph., Westge. turbo, with surf. cond. and auxls.
1—250 KVA., 2300 V., 60 Cy., 3 Ph., G. E. horiz. turbo unit, with surf. cond. and auxls. Used six months.
1—500 KW., 600 V., 60 Cy., 3 Ph. low pressure Allis turbo unit, with cond. and auxls.
1—300 KW., 2300 V., 60 Cy., 3 Ph. Westge. low pressure turbo, with cond. and auxls.
1—125 KW., 480 V., 60 Cy., 3 Ph. noncondensing Westge. turbo.
1—800 KW., 480 V., 60 Cy., 3 Ph., Allis x com. Engine set.
1—1000 KW., 550-600 V., DC x com. Railway Engine set.
1—200 KW., 240 V., DC cross compound Allis Engine set.
3—Refrigerating units, one 8-ton, one 18-ton, one 100-ton.
1—150 KW., 125 V., DC Engine set.
1—550 KW., 35 degree, 250 V., cross compound Engine unit.
1—75 KW., 250 V., DC Engine set.
1—80 KW., tandem compound Engine set.
1—3 KW., 125 V., G. E., gasoline set, with switchboard.
1—12½ KW., 125 V., G. E., DC generator.
1—500 KW., Crocker-Wheeler-Hamilton Corliss x com. Engine set.
1—517 HP., class F, 150 lbs. Stirling boiler.
6—515 HP., B & W, 160 lbs. boilers, with superheaters.
1—100 HP., 440 V., 60 Cy., 3 Ph., 720 RPM. Slip Ring motor.
4—New G. E., 75 HP., 2300 V., 60 Cy., 3 Ph., 900 RPM. form KT motors.
1—50 HP., 900 RPM., 220 V., 60 Cy., 3 Ph., type AN Allis motor.
1—10 HP., Westge. 1800 RPM., single phase motor.
1—5 HP., 1750 RPM. single phase, Wagner motor.
1—200 HP., G. E., 440 V., 60 Cy., 3 Ph., 300 RPM., syn. motor.
1—200 HP., and one 300 HP., 3 Ph., 60 Cy., 440 V., 514 RPM. Westge. syn. motors.
1—Motor-driven, 8-6-5 K Gates crushers, modern rock crushing plant.

Ross Power Equipment Co., Indianapolis, Ind.

TURBO-GENERATORS

2—500 kw. each G. E. vertical, 3 phase, 60 cycle, 2300 volts, 1800 rpm., turbo generator sets, complete with surface condensers.

GENERATORS—3 PHASE, 60 CYCLE.

K.W.		Speed.
175	Westinghouse, 2200 V.	900
150	General Electric, 230 V.	600
90	Electric Machinery, 2300 V.	1200
75	Westinghouse, 2200 V.	720
75	Western Electric, 230 V.	1200

MOTORS—DIRECT CURRENT, 250 VOLTS.

H.P.		Speed.
55	General Electric	900
30	Northern	600
25	Fischer	550
20	C. & W.	750
10	Browning	1000
10	Jantz & Leist	900
10	Cincinnati Elect.	1000
5	Sterling	1800
3	Triumph	1500

MOTORS—3 PHASE, 60 CYCLE. 220-440 VOLTS.

H.P.		Speed.
1—100	General Electric, new	900
2— 50	General Electric, new	900
1— 40	General Electric, new	1200
1— 35	General Electric, new	1200
1— 30	General Electric, new	1200
1— 30	F. & M.	1200
1— 30	Westinghouse vertical	1200
2— 25	General Electric, new	1200
1— 15	General Electric, new	1800
1— 10	General Electric, new	1200

MOTOR GENERATOR SETS.

1—50 kw., Westinghouse, 125 volt, generator, d. c. direct connected to 75 h. p., 3 phase, 60 cycle, 2300 volt, 850 rpm. motor mounted on same base.

1—17½ kw. Bullock, 125 volt, generator, d. c. direct connected to 30 h. p. Westinghouse, 3 phase, 60 cycle, 220 volt motor mounted on same base.

Engines, Boilers, Motors and Generators

The Randle Machinery Co.
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International Clearing House

IMMEDIATE DELIVERY

DIRECT CURRENT MOTORS—220 TO 250 VOLTS.

Items listed below, include rails, pulleys and starters. Standard size pulleys will be furnished. Extra size pulleys will be furnished if required at a small additional cost.

No.	Hp.	Rpm.	Wdg.	Type.	Make.
1	5	1700	SH	SA	Imperial
1	5	1870	SH	CVC	G. E.
3	5	1850	SH	CM	Cr.-Wh.
1	5	1700	SH	CVC	G. E.
1	5	1650	SH	Form A	G. E.
1	5	950	SH	MP	Guarantee
1	5	900	SH	A-5	Gibbs
1	5½	1675	SH	CVC	G. E.
1	7½	1425	SH	CM	Cr.-Wh.
1	7½	585	CP	MP	Northern
1	10	1525	SH	MP	G. E.
1	10	900	SH	MP	Akron
1	15	875	SH	MP	Imperial
1	15	625	SH	CVC	G. E.
1	15	625	SH	G	Eddy
1	17½	600	SH	A-14	Gibbs
1	17½	585	SH	A-14	Gibbs
1	20	800	SH	MP	Imperial
1	20	800	SH	MP	G. E.
1	20	650	SH	MP	Milwaukee
1	20	600	SH	MP	Western El.
1	20	1150	SH	TR	Fbks.-Morse
2	20	975	SH	F	Fbks.-Morse
1	30	950	SH	CS-20	National
1	30	630	SH	MP	Northwestern
1	30	575	SH	K	Allis-Chal.
1	38	590	SH	MP	Gibbs
1	40	675	SH	MP	Northwestern
1	40	620	SH	E60R	Western El.
1	40	575	SH	A-30	Milwaukee
1	40	550	SH	M	Westinghouse
1	50	625	SH	A-40	Milwaukee
2	50	1200	SH	TR	Fbks.-Morse
1	55	575	SH	E6½AOR	W. E.
1	60	850	CP	M	Westinghouse
1	60	500	CP	MP	Milwaukee
1	85	750	CP	CL-65	Gen. Elec.
1	100	680	CP	S	Westinghouse
1	200	450	CP	M	Westinghouse
1	300	160	CP	M	Westinghouse
1	600	320	CP	M7	Westinghouse

3-bearing outfit complete.

DIRECT CURRENT MOTORS—115 VOLTS.

No.	Hp.	Rpm.	Wdg.	Type.	Make.
1	¼	1800	SH	MP	Ft. Wayne
1	½	1000	SH	MP	Sprague
1	1	1800	SH	MP	Westinghouse
1	1	1200	SH	K	Allis-Chalmer
1	2	1200	SH	M	Westinghouse
1	5	1500	SH	M	Westinghouse
1	6	1465	CP	S	Westinghouse
1	7½	1550	SH	K	Allis-Chalmers
1	7½	975	CP	S	Westinghouse
1	7½	450	SH	MP	C. & C.
1	10	825	SH	K	Allis-Chalmers
1	10	1800	SH	MP	Otis
1	10	800	SH	CCM	Cr.-Wh.
1	10	700	SH	A-9-900	Gibbs
1	13	1400	CP	S	Westinghouse
1	15	1200	SH	MP	Northern
1	15	1050	CP	S	Westinghouse
1	20	1100	SH	C-20	Milwaukee
1	20	900	CP	M	Westinghouse
1	22	1050	SH	E-15	Milwaukee
1	25	850	SH	S	Westinghouse
1	25	1000	SH	CD	Wagner
1	26	250	CP	MP	Akron
1	35	500	CP	Form A	Gen. Elec.
2	40	850	CP	M	Westinghouse
1	60	700	CP	M	Westinghouse
1	125	550	CP	MP	Burke
1	45	550	CP	MP	Ideal

DIRECT CURRENT MOTORS—550 VOLTS.

No.	Hp.	Rpm.	Wdg.	Type.	Make.
1	¾	1500	CP		Holtzer-Cabot
1	1¾	1200	SH	MP	Westinghouse
1	7½	1650	CP	CE	G. E.
		1300	SH	MP	Westinghouse
1	8	650/			
1	8	1400	SH	S	Westinghouse
1	10	1500	SH	MP	Peerless
1	10	950	SH	MP	Fbks.-Morse
1	25	800	SH	CL-20	Gen. Elec.
1	50	900	CP	Form A	Gen. Elec.
1	80	640	CP	CQ	Gen. Elec.
1	100	680	SH	CM	Cr.-Wh.
1	200	450	CP	M	Westinghouse
1	300	150	CP	M	Westinghouse
1	600	300	CP	M	Westinghouse

SERIES MOTORS.

No.	Hp.	Rpm.	Volts.	Type.	Make.
1	2	950	115	L	Westinghouse
1	2	800	115	L	Westinghouse
2	1½	1200	250		Thompson
1	25	550	240	12-A	Westinghouse
1	25	550	500	12-A	Westinghouse
1	50	550	500	H8F	Western Elec.

ALTERNATING CURRENT MOTORS —3-PHASE, 60-CYCLE.

No.	Hp.	Rpm.	Volts.	Type.	Make.
1	3	1700	220 or 440	AN	Allis-Ch.
1	3	1130	220 or 440	AN	Allis-Ch.
4	5	1700	220 or 440	AN	Allis-Ch.
14	5	1200	220 or 440	AN	Allis-Ch.
1	5	1200	200 or 440	L	Westg.
3	5	1200	220 or 440	CCL	Westg.
1	5	1800	220 or 440	AN	Allis-Ch.
1	7½	1800	220 or 440	AN	Allis-Ch.
4	7½	1800	220 or 440	AN	Allis-Ch.
11	10	1800	220 or 440	AN	Allis-Ch.
7	10	1200	220 or 440	AN	Allis-Ch.
1	10	840	220 or 440	F	Westg.
1	15	1800	220 or 440	AN	Allis-Ch.
11	15	1200	220 or 440	AN	Allis-Ch.
1	15	860	220 or 440	AN	Allis-Ch.
1	20	1800	220 or 440	AN	Allis-Ch.
1	20	1200	220 or 440	AN	Allis-Ch.
5	20	860	220 or 440	AN	Allis-Ch.
3	25	1200	220 or 440	AN	Allis-Ch.
3	25	900	220 or 440	AN	Allis-Ch.
5	30	900	220 or 440	AN	Allis-Ch.
4	30	860	220 or 440	AN	Allis-Ch.
5	40	860	220 or 440	AN	Allis-Ch.
1	50	720	220 or 440	AN	Allis-Ch.
5	75	900	220 or 440	AN	Allis-Ch.
2	40	1160	220 or 440	AN	Allis-Ch.
1	100	720	2200	AN	Allis-Ch.
4	100	860	220 or 440	AN	Allis-Ch.
1	100	900	2200	AN	Allis-Ch.
1	150	565	440	MS	Westg.
1	150	400	440	MS	Westg.
2	150	720	2200	AN	Allis-Ch.
1	200	720	2200	AN	Allis-Ch.
1	200	1200	2200	AN	Allis-Ch.

All motors complete with rails, pulleys and compensators.

SLIP RING A. C. MOTORS—3-PHASE, 60-CYCLE.

1	50	900	220 or 440	ANY	Allis-C.
2	75	900	220 or 440	ANY	Allis-C.
1	150	720	220 or 440	ANY	Allis-C.
1	30	1200	220 or 440	ANY	Allis-C.

DIRECT CURRENT BELTED GENERATORS—125 VOLTS.

Complete with rails, pulleys and rheostat.

No.	Kw.	Vts.	Rpm.	Wdg.	Type.	Make.
1	4	125	1550	SH	..	Colonial
1	5	125	1200	SH	..	Burke
1	5	125	1600	SH	S	Westg.
1	5	125	1200	SH	..	Burke
1	10	125	1500	CP	S	Westg.
1	11¼	125	1200	CP	..	Westg.
1	7½	125	950	SH	CCM	Cr. Wh.
1	15	125	1050	CP	M	Westg.
1	15	125	750	SH	..	Akron
1	16	125	1165	SH	..	Milw'kee
1	18½	125	1050	SH	S	Westg.
1	20	125	1165	...	CO	Wagner
1	21	125	300	CP	..	Akron
7	25	125	1100	CP	..	G. E.
1	27½	125	600	CP	F'm F	G. E.
2	30	125	950	CP	M	Westg.
1	45	125	850	CP	M	Westg.
1	35	125	650	CP	MP	Ideal
1	100	125	720	CP	..	Burke

DIRECT CURRENT BELTED GENERATORS—230 TO 250 VOLTS.

3	3⅝	230	2000	SH	CM	Cr.-Wh.
1	5½	230	1550	SH	CM	Cr.-Wh.
1	13	230	680	SH	A-14	Gibbs
1	7	230	1650	SH	..	G. E.
1	10	230	950	SH	CM	Cr.-Wh.
1	15	230	950	SH	..	G. E.
1	15	230	1250	SH	TR	Fbks.M.
1	17½	230	1100	CP	Class 4	G. E.
1	22	230	1050	SH	CS-20	Nat'l
1	28	230	700	SH	MP	Gibbs
1	30	230	650	SH	M	Westg.
2	40	230	1300	SH	TR	Fbks.-M.
1	35	230	775	SH	..	N'w'ern
1	40	230	675	SH	..	West. El.
1	45	230	600	CP	MP	M'w'kee
2	56	230	950	CP	MP	M'w'kee
1	75	230	800	SH	S	Westg.
1	90	230	550	CP	MPA	G. E.
1	100	250	575	CP	MP	M.-Gard.
1	150	250	560	CP	M	Westg.
1	450	250	320	CP	M	Westg.

D. C. BELTED GENERATORS—550 VOLTS.

Complete with rails, pulleys and rheostats.

No.	Kw.	Vts.	Rpm.	Wdg.	Type.	Make.
1	22	500	800	CP	S	Westg.
1	37	550	650	CP	MP	G. E.
2	75	550	722	CP	S	Westg.
1	150	550	575	CP	M	Westg.
1	500	550	320	CP	M	Westg.
1	75	550	750	SH	CM	Cr.-Wh.

Switchboards can be furnished for above.

DIRECT CURRENT ENGINE GENERATOR SETS—110 TO 125 V.

Belted sets complete with rails, pulleys and rheostats.

1—21 kw., 125 v., 300 rpm., cp. wd., Akron generator belted to 1 28 hp., 260 rpm., Struthers Wells gas engine complete.

1—21 kw., 115 v., 300 rpm., cp. wd., Akron generator, direct connected to McCall gas engine, twin cylinder 10x11, mounted on common base plate, complete with gas regulator.

1—27½ kw., 125 v., 600 rpm., cp. wd., General Electric generator belted to 1 35 hp., 300 rpm., McCall gas engine complete.

1—30 kw., 125 v., 950 rpm., cp. wd., Westinghouse, Type M generator, belted to Ball engines, complete with all accessories.

1—35 kw., 125 v., 650 rpm., cp. wd., Ideal generator belted to 1 48 hp., 290 rpm., Ball steam engine complete.

1—100 kw., 125 v., 720 rpm., cp. wd., Burke generator, 6-pole, belted to Lord Howler steam engine, complete with all details.

1—100 kw., 125 v., 250 rpm., cp. wd., Westinghouse generator, direct connected to 11½x19x14 Ball Cross Compound engine.

1—381 kw., 125 v., 150 rpm., cp. wd., Westinghouse d. c. generator, direct connected to 500 hp., 18x32x24 Atlas Tandem Compound steam engine.

Switchboards can be furnished with the above sets at an additional price.

DIRECT CURRENT ENGINE GENERATOR SETS—230 TO 250 V.

Belted sets complete with rails, pulleys and rheostats.

1—17½ kw., 230 v., 1100 rpm., cp. wd., G. E. generator, belted to 1 28 hp., 250 rpm., Champion gas engine complete.

1—55 kw., 230 v., 950 rpm., cp. wd., Milwaukee generator, belted to 12 x14 McEwen steam engine, 250 rpm., complete with all accessories.

1—90 kw., 250 v., 550 rpm., cp. wd., G. E. generator belted to 1 125 hp., 220 rpm., Lord-Howler steam engine complete.

1—75 kw., 220 to 230 v., 270 rpm., Westinghouse generator, cp. wd., 6 pole, direct connected to 1-American Ball steam engine.

1—75 kw., 250 v., 275 rpm., cp. wd., Northern Electric generator direct connected to 1-Erie steam engine complete.

1—75 kw., 230 v., 800 rpm., sh. wd., Type S Westinghouse generator belted to one 125 hp., Lord Howler steam engine complete.

4—110 kw., 250 v., 225 rpm., cp. wd., Morgan-Gardner generators, belted to Skinner steam engines 16x18.

1—110 kw., 250 v., 600 rpm., cp. wd., Burke Electric generator belted to National Transit gas engine. Set complete with compressor and accessories.

1—450 kw., 250 v., 300 rpm., cp. wd., Westinghouse 3-Bearing Generator, belted to Allis-Chalmers Corliss steam engine, 150-lb. steam pressure.

Switchboards can be furnished with above sets at an additional price.

DIRECT CURRENT ENGINE GENERATOR SETS—550 VOLTS.

Belted sets complete with rails, pulleys and rheostats.

1—75 kw., 550 v., 800 rpm., sh. wd., Type CM, Cr.-Wh. generator belted to 1 125 hp., 220 rpm., Lord Howler engine.

1—60 kw., 550 v., 750 rpm., cp. wd., Type CQ, General Electric generator belted to 91 hp. McEwen steam engine complete.

1—37½ kw., 550 v., 1000 rpm., cp. wd. Form A, G. E. generator belted to 1 48 hp., 290 rpm., Ball steam engine.

1—75 kw., 550 v., 800 rpm., sh. wd., Type S, Westinghouse generator belted to 1 125 hp., 220 rpm., Lord Howler engine.

1—100 kw., 550 v., 275 rpm., Type LL5½ Western Electric cp. wd. generator, direct connected to Harrisburg engine, complete with all accessories.

1—100 kw., 550 v., 275 rpm., Type L5½ Western Electric cp. wd. generator direct connected to Ball Engine No. 4313, complete with all accessories.

1—150 kw., 550 v., 560 rpm., Type M, cp. wd., complete with rails, pulley and rheostat, belted to McEwen steam engine, 233 hp., 19"x18", complete with flywheel.

1—160 kw., 550 v., 250 rpm., cp. wd., Burke generator, direct connected to 21x18 Harrisburg steam engine.

1—500 kw., 550 v., 320 rpm., cp. wd., Westinghouse 3-Bearing generator belted to Allis-Chalmers Corliss steam engine, 150-lb. steam pressure.

Switchboards can be furnished with the above sets.

A. C. ENGINE GENERATOR SETS.

Belted sets, complete with rails, pulley and rheostats.

Qu.	Kva.	Volts	Rpm.	Ph.	Cy.	Gen. Make	Eng. Make.
1	50	110					
		200					
		400					
		600	1200	3	60	G.E.	McE. st'm
1	60	1100	900	2	60	West.	Ideal gas
1	75	2300	900	3	60	G.E.	Arm'g't'n Sims steam
1	120	1100	720	2	60	West.	Ide&Sons
1	175	2300	225	3	60	W.E.	Weber st'm
1	175	2300	225	3	60	W.S.	Shfld. st'm

Switchboards can be furnished with above units.

MOTOR GENERATOR SETS—220 TO 250 VOLTS.

1—55 kw., 250 v., 975 rpm., cp. wd., Milwaukee generator, belted to new 3-phase 60-cycle, 220 or 440 v., 860 rpm. Allis-Chalmers motor.

1—75 kw., 250 v., 860 rpm., sh. wd., Type S, Westinghouse generator direct connected to New 220 or 440 v., 3-phase, 60-cycle Allis-Chalmers motor complete.

1—100 kw., 250 v., 1200 rpm., cp. wd. with interpoles, new C. & C. generator, mounted on common base and direct connected to new 2300 v., 3-phase, 60-cycle Allis-Chalmers motor complete.

1—150 kw., 250 v., 1200 rpm., cp. wd., with interpoles, new C. & C. generator, mounted on common base and direct connected to new 2300 v., 3-phase, 60-cycle Allis-Chalmers motor complete.

1—500 kw., 350 rpm., 250 v., d. c., cp. wd., Type M, Westinghouse generator direct connected to 2200 v., 3 ph., 60 cy., Westinghouse slip ring motor, with starting equipment and switchboard.

Switchboards can be furnished with above sets.

MINING MACHINES.

No.	Type.	Volts.	Make.	Gauge.	Cut.
1	SS	250	Morgan Gardner		42"6'

ELECTRIC FANS.

No.	Type.	Size.	Volts.	New or Used.	Make.
1	OSC	12"	110 D.C.	Used	G. E.
9	S&T	12"	110 D.C.	Used	West.
1	S&T	16"	110-115 D.C.	Used	West.
8	Ceiling	15"	110 D.C.	Used	Gyrofan
1	Ceiling	16"	110 D.C.	Used	Diehl
11	S&T	12"	110 A.C.	New	Jandus

EXHAUST FANS.

No.	Hp.	Size.	Volts.	New or Used.	Make.
1	1¼	24"	230 D.C.	Used	N'thw'st
1	...	24"	110 D.C.	Used	Lackman
1	1.85	36"	230 D.C.	Used	N'thw'st

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or
Chicago Office, 230 S. La Salle St., Chicago, Ill.

International Clearing House

K. W.—125 VOLT DYNAMOS—SPEED.

1—	7½	Fairbanks-Morse, interpole	1700
1—	8¼	Crocker-Wheeler	1375
1—	30	Gen. Elec.	1050
1—	33	Westinghouse	950
2—	45	Gen. Elec., interpole, type DLC	775
1—	55	Gen. Elec.	875
1—	60	Westinghouse	800
1—	65	Crocker-Wheeler	625
2—100		Allis-Chalmers, 6-pole	650
1—100		Westinghouse, direct-connected to Harrisburg tandem-compound engine	275

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QUALITY AT A REASONABLE PRICE.

110-220 Volt, 60 Cycle, 1750 R.P.M.

2	H.P.	$100.00
1	H.P.	72.00
½	H.P.	51.00
¼	H.P.	40.00

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3 Phase, Slip Ring, 1200 RPM., 10-30 and 50 HP.
Squirrel Cage, 1200 RPM., 30 and 50 HP.
Squirrel Cage, 900 RPM., 40 and 50 HP.

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H.P.	Make.	Speed.	Type.
35	Stanley	900	Sq. Cage
35	West. Elec	900	Sq. Cage
40	Whse.	850	Sq. Cage
40	G.E.	900	Sq. Cage
40	Lincoln	1800	Sq. Cage
2-40	G.E.	514	Sq. Cage
40	G.E.	900	Sq. Cage
40	G.E.	1200	Sq. Cage
40	G.E.	600	Wound rotar.
50	Whse.	700	CCL.
50	G.E.	720	Slip Ring.
50	Whse.	600	K.

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3—300 K.W., 125-250 Volt, 3 Wire Units, Compound Engines.
4—150 K.W., 125-250 Volt, 3 Wire Units, Compound Engines.
1—250 K.W., 250 Volt Unit.
2—100 K.W., 1—75 K.W. and 1—50 K.W. 250 Volt Units.

Boilers.

6—150 H.P. Heine, 150-lb. pressure.
7—250 H.P. and 2—500 H.P. Stirling, 150-lb. pressure.
5—229 H.P. and 2—305 H.P. B. & W., 160-lb. pressure.
1—305 H.P. B. & W., 200-lb. pressure.
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Complete Power Plants designed and erected.

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Electric Fans. Give price and complete description in first letter.

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1—750 K. V. A., 440 volts. Generator, direct connected with Curtis Vertical Turbine. Immediate shipment.

NATIONAL PRODUCTS COMPANY,
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WE CAN SHIP TONIGHT

any size motor up to 150 H. P. in 3 phase, 60 cycle, 220 volts, 440 volts or 550 volts.

Our stock of 110 volt, 220 volt and 500 volt direct current motors is complete.

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Tabulated or paragraphed advertisements will be charged at twenty cents a line.
If replies are in care of this office, allow five words for the address.

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HIGH GRADE MAN WITH EXECUTIVE ability and training; experienced in systematic purchasing, storekeeping, cost and general accounting, general organization. American, 34 years old. Address Box No. 3115, Electrical Review, Chicago.

WANTED — POSITION AS SUPERINtendent; eighteen years' practical experience in central station operations, electric, water and steam; references; Wisconsin preferred or Illinois. Address No. 3200, Electrical Review, Chicago.

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WANTED — DRAFTSMAN ON POWER switchboards. Must understand theory of polyphase connections. State experience and salary expected. Address Box 3201, Electrical Review, Chicago.

AMBITIOUS TECHNICAL STUDENTS or young wide awake electricians offered an exceptional opportunity to obtain broad training and wide experience in the handling of all classes of electric apparatus as testers of the product of large manufacturer. Permanent positions at good wages and unlimited advancement open to those "making good." Address Box 3107, Electrical Review, Chicago, Ill.

SALESMAN (DRAFT EXEMPT) CAPable of making $3,000 to $5,000 per year, for western Ohio territory, by old established and favorably known specialty manufacturer. One who is well acquainted with the jobbing trade in this territory preferred. Extensive publicity has created a ready market for the line and its money-making possibilities are really limited only by the salesman's own efforts. Give all details, including age, experience, references, etc., in first letter. Address Box 3203, Electrical Review, Chicago.

WANTED — LICENSED ELECTRICIAN for permanent position. Good wages. City & Homes Company, 624 Madison Ave., New York City.

WANTED — TECHNICAL MEN — RECent technical graduates in electrical or mechanical engineering preferred, by large public utility company, operating in North and South Carolina. Positions are on course of training giving experience in the different branches of public utility work to fit men for permanent positions with company. Apply, giving age, education, experience, references and salary expected; also state whether married or single and status as to national draft. Enclose photograph or kodak picture of self that will be returned if desired. Address No. 3204, Electrical Review, Chicago.

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ADDITIONAL CAPITAL WANTED — Five to ten thousand dollars, with competent man attached as general manager, to open up in connection with our retail supply, fixture and electrical contracting business. Capital paid up, $20,000; business in good shape and established 2½ years. Dividend 16% per cent. Prompt action desired. Want to retire on account of age. Would sell business. Annual sales, 1917, $65,000. Address Box 841, Miami, Fla

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One 800 KW. General Electric, 2300 volt, 3 phase, 60 cycle, Alternater, direct connected to McIntosh & Seymour horizontal heavy duty engine, 100 RPM.

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PROPOSALS.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 15, 1918.—Sealed proposals will be opened in this office at 3 p. m., July 12, 1918, for changes in the conduit and lighting system in the United States post office and court house, Pittsburgh, Pa., in accordance with the specification and drawings, copies of which may be had at this office or at the office of the custodian, Pittsburgh, Pa., in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 13, 1918.—Sealed proposals will be opened in this office at 3 p. m., June 5, 1918, for supplying to the various federal buildings, marine hospitals and quarantine stations under the control of the Treasury Department portable desk lamps during the fiscal year ending June 30, 1919, in accordance with the drawing and specifications, copies of which may be had at this office, in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 10, 1918.—Sealed proposals will be opened in this office at 3 p. m., July 10, for the installation complete of two new electric passenger elevators, etc., in the United States post office and court house, Detroit, Mich., in accordance with the drawings and specifications, copies of which may be had at this office, in the discretion of the Supervising Architect.—James A. Wetmore, Acting Supervising Architect.

D. C., June 10, 1918.—Sealed proposals will be opened in this office at 3 p. m., July 10, 1918, for repairs to heating, plumbing, conduit and wiring, lighting fixtures, etc., in the U. S. Court House, etc., at Santa Fe, N. M., in accordance with the drawing and specification, copies of which may be had at this office or at the office of the Custodian at Santa Fe, N. M., in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

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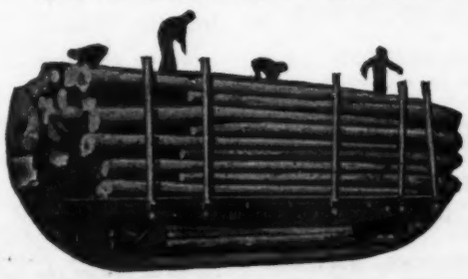

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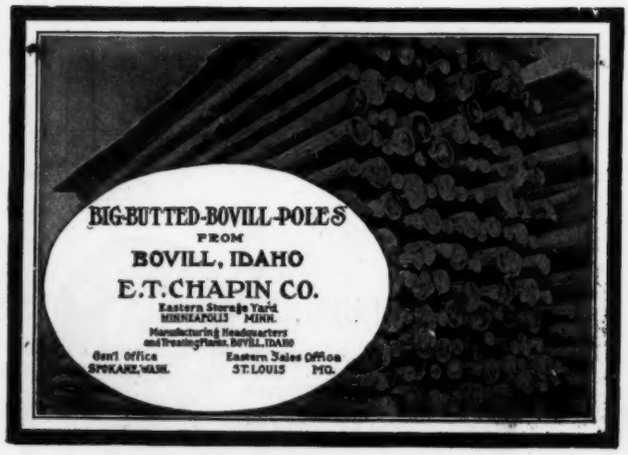

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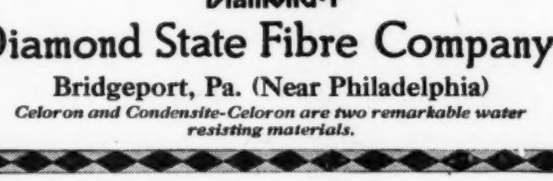

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CLASSIFID INDEX OF ELECTRICAL REVIEW.
VOL. LXXXII. NO. 25.

Hydroelectric Development in Iron Mountain Region..1027
The Central Station and the Industrial Electric Heating Load.—By Arthur F. Allsop.....1029
War Conservation of Power and Light.....1034
Effect of War Upon Public Utilities.—By H. Wurdack 1037
Ways Devised for Increasing Public Utility Income Without Undue Expenditures 1047
Phantom Circuit for Current Transformers—By M. Graham 1049
Steam-Flow Meters Solve Firebrick Troubles.—By Lionel Linnell 1049
A Protective Covering for Steel Towers.....1051
Bending Racks and Roll Benders for Large Conduit and Pipe.—By Terrell Croft 1052

SOCKETS AND RECEPTACLES.
Benjamin Electric Mfg. Co.
Central Electric Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hubbell, Inc., Harvey.
Ostrander & Co., W. R.
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Moore, Alfred F.
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Okonite Co., The
Page Steel & Wire Co.
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Roebling's Sons Co., John A.
Rome Wire Co.
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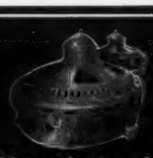
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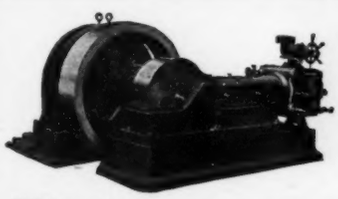
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Alphabetical Index to Advertisements

A

Adams-Bagnall Electric Co. 14
Advance Electric Co. 42
Allen Co., Inc., L. B. 55
Allis-Chalmers Mfg. Co. 2
American Engineering Co. 18
American Bridge Company 24
American Circular Loom Co. 20
American Conduit Co. 53
American District Steam Co. 58
American Electric Co. 52
American Electrical Works 47
American Engineering Co. 18
American Platinum Works 45
American Sheet & Tin Plate Co. 51
American Steel & Wire Co. 48
American Telephone & Telegraph Co. 26
American Vulcanized Fibre Co. 22
Anderson Mfg. Co., Albert & J. M. 55
Apex Electrical Distributing Co., The 10
Arnold Co. 58
Ashland Electric Co. 43
Atlantic Insulated Wire & Cable Co. 46

B

Babcock & Wilcox Co. 44
Baehr, Wm. A. 58
Baker & Co., Inc. 54
Bates Expanded Steel Truss Co. 26
Belden Manufacturing Co. 48
Benjamin Electric Mfg. Co. 16
Boustead Electric Mfg. Co. 42
Brady Electric Mfg. Co. 45
Breco Electric Co. 6
Business Opportunities 43
Byllesby & Co., H. M. 58

C

Central Electric Co. 15
Century Electric Co. 37
Chapin Co., E. T. 45
Chicago Fuse Mfg. Co. 7
Clifton Manufacturing Co. 53
Cooper Hewitt Electric Company 28
Croft Engineering Co., Terrill 58
Cutler-Hammer Mfg. Co. 29
Cutter Co., Geo. 17

D

Daum, A. F. 6
Davis Slate & Mfg. Co. 53
Diamond State Fibre Co. 53
Duluth Log Co. 45
Duncan Electric & Mfg. Co. 50
Duquesne Electric & Mfg. Co. 41
Duvall, E. S. 58

E

Eck Dynamo & Motor Co. 55
Economy Fuse & Mfg. Co. 9
Edison Electric Appliance Co., Inc. ..... Front cover, 27
Electric Controller & Mfg. Co. 21
Electric Machinery Co. 55
Electric Storage Battery Co., The 51
Electrical Testing Laboratories 20, 58
Electro Dynamic Co. 55
Emerson Electric Mfg. Co. 49
Enterprise Electric Co., The 44

F

Federal Sign System (Electric) 8
For Sale 43
Freydberg Bros., Inc. 37

G

Garfield Mfg. Co. 51
General Electric Co. 32, 33
Godfrey, John F. 49
Goodrich Rubber Co., B. F. 60
Gregory Electric Co. 42

H

Hartford Time Switch Co. 37
Help Wanted 43
Hotel McAlpin 44
Hubbell, Harvey, Inc. 8
Humbird Lumber Co. 45

I

Illinois Electric Porcelain Co. 52
Indiana Rubber & Ins. Wire Co. 34
International Clearing House 38, 39, 40, 41, 42 43
Ivanhoe-Regent Works of General Electric Co. 13

K

Keystone Lubricating Co. 49
Klein & Co., Nathan 42
Kuhlman Electric Co. 10

L

Lindsley Bros. Co. 45
Lyndon, Lamar 58

M

Manhattan Electrical Supply Co. 50
MacGovern & Co., Inc. 38
Mayer, F. 40
Mica Insulator Company 52
Miscellaneous 43
Moore, Alfred F. 48
Morse Chain Co. 30
Myerson, Joseph 39

N

National Carbon Co. 37
National Conduit & Cable Co. 47
National Electrical Exchange 42
National Lamp Works of General Electric Co. 12
National Metal Molding Co. 6
National Pole Co. 45
National Products Co. 42
Naugle Pole & Tile Co. 45
New England Butt Co. 46
New Process Gear Corporation 22
New Process Specialty Co. 22
New York Insulated Wire Co. 48
Northern White Cedar Association 19
Northwestern Electric Co. 52
Norma Co. of America 51

O

Okonite Co. 34
Oshkosh Mfg. Co. 10

P

Page & Hill Co. 45
Paragon Electric Co. 54
Partridge, Arthur S. 43
Partridge Lumber Co., T. M. 45
Peerless Electric Co. 24
Phillips Wire Co. 47
Pittsburgh Transformer Co. 44
Positions Wanted 43
Power Equipment Co. 42
Proposals 43

R

Radium Chemical Co. 20
Randle Machinery Co. 40
Ridgway Dynamo & Engine Co. 55
Ridion, Frank 42
Robbins & Myers Co. 25
Roebling's Sons Co., John A. 47
Rome Wire Co. 46
Ross-Gould List & Letter Co. 37
Ross Power Equipment Co. 40

S

Sachsenmaier Co., George 39
Safety Ins. Wire & Cable Co. 49
St. Louis Electric Works 24
Samson Cordage Works 37
Sargent & Lundy 58
Schweitzer & Conrad, Inc. 54
Shaw Lightning Arrester Works 49
Siggers, E. G. 58
Simplex Wire & Cable Co. 34
Sorgel Electric Co. 42
Stone & Webster 58

T

Thordarson Elec. Mfg. Co. 50
Torrey Cedar Co. 45
Trumbull Electric Mfg. Co. 52
Tupper, C. A. 58

U

Underwriters' Laboratories 58
United States Rubber Company 23
Utilities Indemnity Exchange 50

V

Valentine-Clark Co. 45
Vibration Specialty Co. 44
Vindex Electric Mfg. Co. 42

W

Wagner Co., Arthur 43
Walker Bros. & Haviland 55
Want Advertisements 43
Western Electric Co. 31
Westinghouse Electric & Mfg. Co. 4, 5
Weston Elec. Instrument Co. 34
White Companies, J. G. 58
Wiggins Co., John B. 50
Woodmansee-Davidson Engineering Co., Inc. 58

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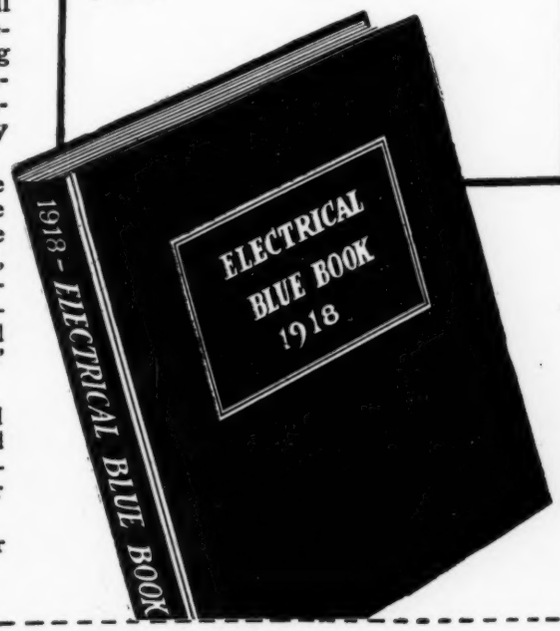

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